The FOUNDRY

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Castings Run Up the Curtain as the Show Goes On

GRAY iron castings undoubtedly are far from the minds of theater patrons as they wait for the curtain to rise, yet many tons of castings are required to balance the weight of the scenery and thus make possible the quick and silent shifting of scenes. The average theater uses from 16 to 20 tons of weights, and an eastern foundry recently made 35 tons of cast weights for the new Atlantic City auditorium. A typical scenery weight unit is of rectangular shape, 3 x 3 x 12 inches, and has cable grooves at each end. The weights are supplied in small sections which have been fairly well standardized. Some idea of the extent of the demand for scenery weights may be secured by considering the fact that more than 400 theaters in New York alone require this equipment. At a conservative estimate of 15 tons of weights to a theater, these show houses are using a total of 6000 tons of weights. As new scenery often is added to the theater equipment, there is a constant demand for scenery weights from operating show houses as well as from the many new theaters that constantly are being built. Other castings are used in the theater including the frames holding the pulleys over which the scenery cables pass, the switchboard mountings, spot light frames and clamps, cleats for fastening ropes, stair treads and seat frames.

Cast Scenery Weights Are an Essential Part of the Modern Stage Equipment

Find Where Castings Can Be Sold.

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Casts Piston Rings Individually

WHEN it first was discovered that liquids and gases could be used to provide power for driving other machinery through the displacement of a piston in a stationary cylinder, the need for a medium that would insure a tight seal between the moving piston and the cylinder wall was recognized. While the piston could be machined to fit the cylinder perfectly, this condition did not last long as either the cylinder wall or the piston would wear sufficiently to allow the propulsive medium to creep between the two with a resulting loss of power. It also was difficult to lubricate the large area of contact between the two surfaces.

Eventually, it was discovered that if the piston was made slightly smaller than the cylinder and if narrow rings, with enough tension to press outward against the cylinder wall, were placed in grooves in the pistons. an excellent seal was provided against the escape of gases along the side of the piston. This method also gave a comparatively small area of contact to be lubricated, and this was aided by the lubricant being carried in the spaces between the rings.

Since the majority of the machines using the principle of piston displacement have the cylinders and pistons made in cast iron, it was natural to turn to that material for the rings. These are made in a variety of ways and include those cast centrifugally in the form of the so-called piston-ring pots from which a number of rings are cut, piston-ring pots cast in green sand, and individual rings cast in green sand. The rings or ring pots are cast sufficiently over-size so that after machining and cutting the gap or opening in the ring, the ring will just fit the cylinder with only a slight space between the two parts of the ring forming the gap. Usually the large sized piston rings are cast individually while the smaller sizes are cast in what are known as pots. These pots are hollow cylinders which vary in diameter, thickness of wall and in length according to the kind of ring desired and the equipment used for cutting-off the rings. While this method of casting rings is practiced in many foundries, a few companies investigated the possibilities of making rings of all sizes individually. Results obtained showed that the method was

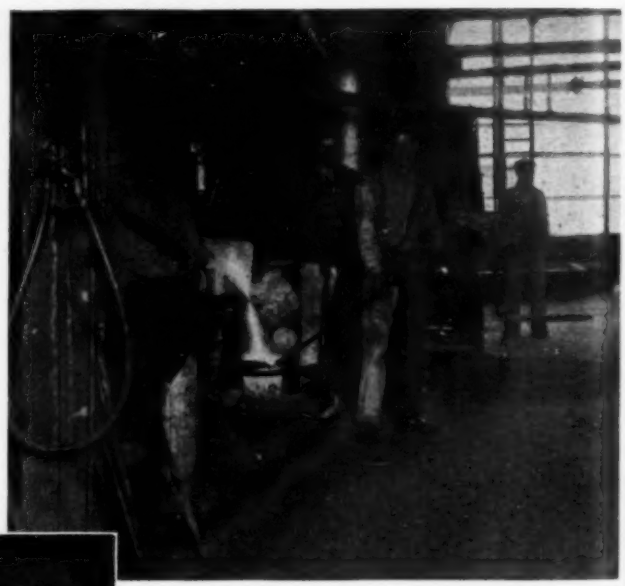


Fig. 1—Below—A View Taken from Inside the Turntable Showing the Molding Stations

By
Edwin Bremer

practical and that it had advantages over the piston pot method. However, a great many difficulties had to be overcome before the casting of piston rings individually could be placed upon a production basis. These included the development of a method of ramming which would produce a mold neither too hard nor too soft, and a means to prevent chilled or hard portions in the light castings.

Fig. 2—Left—Pouring the Molds. Fig. 3—Above—Close-up of the Molding Machine

One firm engaged in producing rings by this method is The Piston Ring Co., Muskegon, Mich. Approximately 38 tons of iron per day is poured into piston rings which may run in size from 5/8 to 64 inches in diameter. The mere mention of the tonnage poured each day does not express the output as well as a statement of the number of castings produced. The total output ranges from 300,000 to 320,000 rings every working day.

Pattern vaults of the firm contain approximately 7000 patterns of various sizes. The rings are mounted on plates up to the 38-inch size; above that size they are loose. The number of rings mounted on a plate varies from 1 to 12 depending upon the ring diameter. Both round and square pattern plates are used, and when not in use are placed vertically on the pattern vault shelves as shown in Fig. 4. This view also shows the largest and smallest ring patterns used in the foundry.

Metal for the rings is melted in three cupolas which were supplied by the Whiting Corp., Harvey, Ill. Two of these are used for small rings and operated on alternate days. The third is used for large rings and operated as required. The small ring cupolas are lined to approximately 38 inches inside diameter. Metal charges consisting of 800 pounds are used with 130 to 150-pound coke splits between. Raw material for the iron charges is composed of pig iron and foundry return scrap only. No foreign scrap is used.

The average analysis at the spout for rings under 5-inch diameter is: Silicon, 2.85 per cent; total carbon, 3.50 per cent; manganese, 0.60 to 0.70 per cent; sulphur, under 0.08 per cent; and phosphorus, 0.50 per cent. Rings 5 inches and over in diameter are made from iron containing 2.00 per cent silicon and 3.65 per cent total carbon. The other elements are about the same as previously given.

Pig iron and molding sand are stored in bins in the basement of the foundry as shown in Fig. 5. Each car of pig iron is placed in a separate bin and an analysis made. As shown in Fig. 5, the pig iron is weighed into a charging box which has four separate compartments, and is mounted

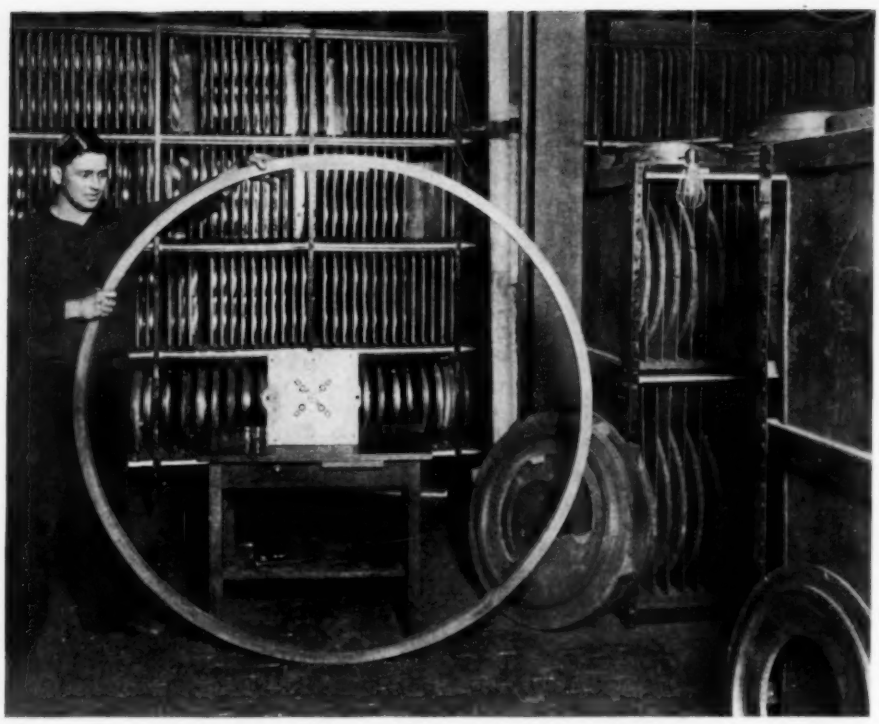


Fig. 4—Pattern Vault Showing Method of Pattern Storage and the Patterns for the Largest and Smallest Rings Produced

on wheels. This charging box is suspended from an automatic scale supplied by the Fairbanks Co., New York. The scale is suspended from two double-wheeled trolley trucks mounted on a monorail system. A chain and wheel attached to suitable gears and shown at the upper left of the device, is used to raise and lower the charging box.

The bulk of the molding is accomplished on specially designed squeezer-type molding machines developed by C. E. Johnson, president of the firm. The machines are operated in conjunction with a circular mold conveyor and sand handling system designed by the firm and installed by the Lamson Co., Syracuse, N. Y. Views of the molding machines and the conveyor are shown in Figs. 1, 2, 3, 6 and 9. The conveyor is in the form of a turntable 90 feet in diameter with a platform about 4 feet wide which conveys the molds from the molding stations to the pouring station and thence to the shakeout. From the shakeout the empty flasks are trucked back to the molding stations. Fifty molding stations are provided with 25 arranged on the outside of the conveyor and 25 on the inside. Fig. 1 is a view taken from inside the conveyor and shows the arrangement of a few of the molding stations.

Sand for the molding machines is distributed by an overhead, scraper-type conveyor as shown in Fig. 6. The scraper arms, moving around slowly, push the sand to the various hoppers over each molding station. The illustration also shows the main storage hopper at the extreme left, the small hopper which holds the sand just previous to reconditioning, and the sand mixing apparatus. When the castings are shaken out, the sand drops through a screen as shown in Fig. 9 on a conveyor belt which passes over a magnetic pulley supplied by Cutler-Hammer Inc., Milwaukee, which removes any tramp iron from the sand.

Breaks Sand Lumps

From the magnetic pulley and belt the sand drops on an electric vibrating screen made by the W. S. Tyler Co., Cleveland, which breaks up any lumps that may have been formed, and then falls on a cross conveyor belt which caries it to the boot of an elevating conveyor. The elevator lifts the sand to a storage hopper, which has a capacity of about 5 tons and is situated above two sand mulling machines made by the National Engineering Co., Chicago. A traveling gate or short apron conveyor under the bin opening removes the sand from the bin and empties it into a steel bucket mounted on trunnions.

Tilting the bucket to one side or the other permits the sand to be emptied in either of the two sand mullers previously mentioned. New sand and water then are added to the batch in the muller and a sufficient time is allowed for the device to incorporate the materials into a homogeneous mass. Following this operation the gate at the bottom of the muller is opened and the sand drops on a short conveyor belt which

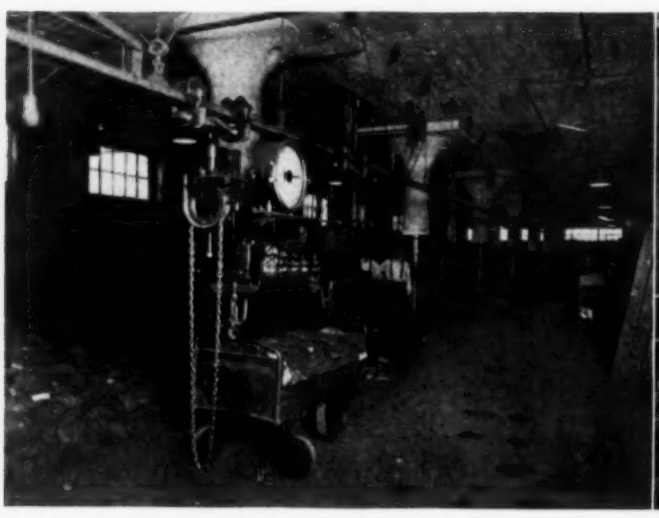


Fig. 5—Pig Iron and Molding Sand Are Stored in the Basement. The Scale Is Suspended from a Monorail. Fig. 6—Scraper Conveyor Above the Turntable Transports the Sand

carries the sand to an elevator. From the elevator the sand is discharged through an aerating device manufactured by the Newaygo Engineering Co., and falls on a horizontal belt which transports the sand to a 75-ton storage bin shown at the extreme left in Fig. 6. As sand is needed in the molding system, it is removed from the bin to a conveyor belt which discharges the sand through an aerating device similar to that previously mentioned. The sand then falls on another belt which carries it to the scraper conveyor system. All new sand used in the system is milled before being added to the old sand. Moisture content of the sand is determined by an electrical measuring device made by the McIlvaine Co., Chicago.

Fig. 9—Shakeout Stations Are Arranged in Pairs. The Sand Is Removed from the Flasks by a Jolted Grid

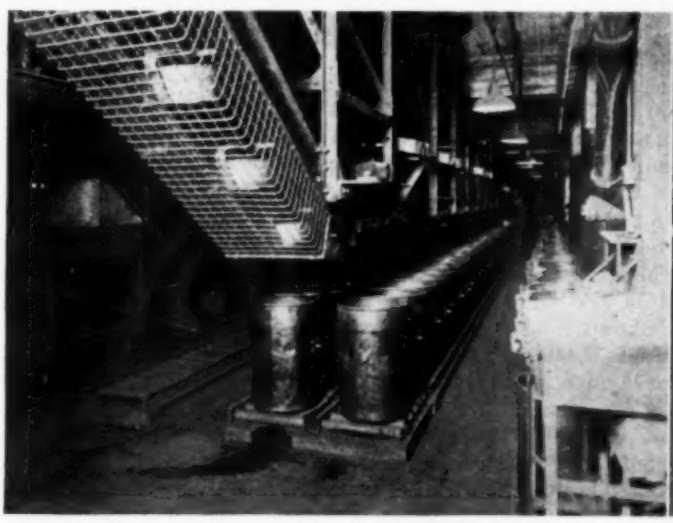
Stack the Molds

Piston rings made by The Piston Ring Co. are produced by multiple molding, that is to say the molds are stacked and have one central sprue feeding metal to the various cavities in the molds. The method employed by the firm requires a stack of twelve molds. Since the cavity is on the bottom of the mold, the first mold laid down is a blank. However, the sprue hole is filled up and the top struck off smoothly and this surface forms the drag for the following mold. The top of this mold and of succeeding molds are squeezed smooth and from the drag of the mold placed on top. The cavity in each case is formed in the under side of the mold. Fig. 3 shows one of the molding machines, the flasks and the shallow upset ring or sand frame used to provide sufficient excess sand for proper operation of the squeezer. The machine shown uses a round pattern plate and flasks, but as previously mentioned, square plates and flasks also are used.

While not evident in the illustration, the ring patterns are slightly oval instead of perfect circles. This is due to the insertion of a small piece in the pattern to provide excess metal for the gap or slot which is cut during the machining operations. This extra piece varies in length depending upon the size of the ring, the type of gap desired and the tension required in the finished ring. It is placed in the pattern at that point where the branch gate is attached to the pattern. With the smaller and lighter metal-section rings, precautions must be taken to prevent hard or chilled spots which are likely to occur at the point farthest from the gate.

In such instances a small piece of metal is attached by a thin branch gate to the pattern. This piece of metal is known as a button and is located outside the ring diametrically opposite the ingate. This button forms a cavity in close proximity to the ring cavity, and when filled with molten metal supplies sufficient heat to retard the cooling to such an extent as to prevent chilling in its vicinity.

In molding, the machine operator places a flask with the upset ring in position on the pattern plate. The upset ring is about ½-inch deep and is equipped with four equally spaced



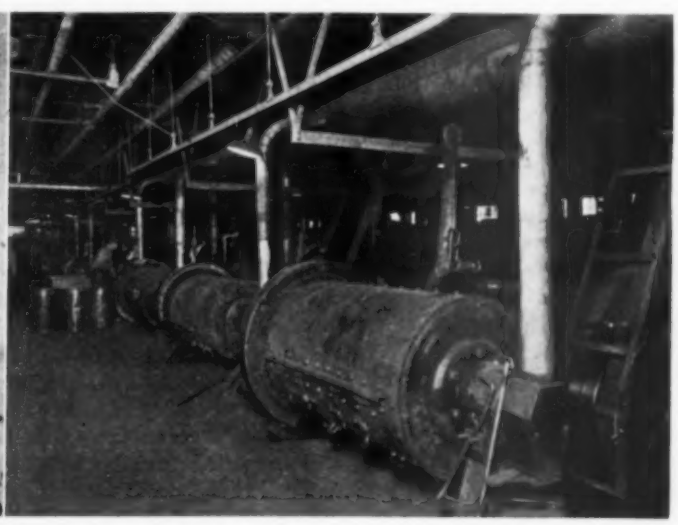


Fig. 7—Various Sizes of Rings Made by Each Molder Are Kept in Separate Barrels. Fig. 8—Nineteen Tumbling Barrels Are Used to Clean the Rings

projections which fit on the outside of the flask to hold it in place. The operator opens the gate of the sand hopper, and breaks the direct fall of the sand on the patternplate by interposing a coarse foundry riddle in the stream. He then tucks the sand lightly around the edge of the flask, scoops up enough sand from that which has fallen outside the flask to level-off the upset ring, and strikes off the excess sand.

Rams The Mold

He removes the ring and squeezes the mold. Squeezing is accomplished by lowering the squeezer plate which is hinged at the back of the machine and shown in the vertical or lifted position in Fig. 3. The squeezer plate is maintained in the horizontal position by a slotted arm which engages a projection on the plate and which is operated by a lever on the lower right side of the machine. Another lever nearby opens the valve to the piston which raises the pattern platen and forces it against the squeezer plate. After the squeeze, the pattern platen is lowered to the normal position.

The operator then proceeds to lift the flask from the pattern. He is assisted in this by a vibrator and lifting pins which provide a straight lift, and which are operated by a knee-valve on the front of the machine. The knee-valve consists of two valves, one for operating the vibrator and the other for raising the lifting pins. The mechanism of the valves is arranged so that as the operator presses on the valve, the vibrator begins to operate. When he presses a little harder, the second valve on the lifting pins opens and the pins are lifted. The double valve mechanism leaves both hands of the operator free to pick up the flask and set it to one side.

As the molds are made they are placed on a flat steel plate adjacent and level with the moving platform of the conveyor. As mentioned previously the molds are stacked one on the other until 12 have been completed, and then the whole stack is pushed on the slowly moving platform. Just before the molds reach the pouring station in front of the cupola, the runner basin is placed over the sprue opening. These runner basins are made of cast iron and are in the form of hollow prismoids. They are about ½-inch thick, 2 inches across at the widest part and 1-inch at the narrowest, about 4 inches long, and 1-inch high. Since they are prismoidal in shape, the sides taper and the wider opening rests on the sand. Before being placed over the sprue opening, the runner basins are dipped in a liquid blacking composed of plumbago and kerosene.

When the molds reach the pouring station in front of the cupola, they are poured by a crew of 8 men using 50-pound shank ladles as shown in Fig. 2. To eliminate any stepping up or down the cupolas are built on a large concrete platform raised about two feet above the floor level. This platform is the same height as the conveyor turntable as may be observed in Fig. 2.

After the molds are poured on the continuous conveyor, they are moved around slowly until the shakeout is reached a short distance from the pouring station. At this point the molds are pushed off the turntable on short roller conveyors placed at right angles to the main conveyor. The roller conveyors carry the molds to the shakeout stations shown in Fig. 9. There are six stations, which, as may be observed in the illustration, are arranged in pairs with a dust removing pipe between. The molds are removed from the roller conveyor and placed upon the shakeout grid. The hook of a small overhead air-hoist is attached to the end of the sprue which is enlarged as previously mentioned by the runner basin.

Shake Out the Molds

The jolter connected to the shakeout grid is started, and in a few seconds the sand is removed from the flasks and from around the rings as shown in Fig. 9. The rings still attached to the sprue are raised vertically through the flasks which then are placed upon a short roller conveyor which returns them to the conveyor turntable. The hoist and the rings are swung to the front of the shakeout where the rings are stripped from the sprue and drop into a metal pan about 4 inches deep and 15 inches in diameter placed beneath the metal funnel which the workman in Fig. 9 is touching. The rings are stripped rapidly from the sprues by workmen who draw their hands down over the rings. Little pressure is needed to break the rings from the branch gates which attach them to the sprue. Each molder places a metal tag on the top of each set of molds he makes, and this metal tag is placed in the pan with the rings at the shakeout.

Each group of rings made in the multiple mold is placed in a separate pan. The pans then are placed on a carrier-type conveyor, containing freely swinging arms which allow the pans to maintain a horizontal position, and carried to the basement as shown in Fig. 7. As the pans arrive in the basement, the contained rings are distributed in the steel barrels according to size and molder's number. In other words, each size of ring made by the same molder is kept in a separate barrel. This method is followed through all the operations including machining. Consequently at any time, defective rings from any cause may be traced back to the molder who produced them.

As the barrels are filled, they are taken to the tumbling department which also is located in the basement. The rings are tumbled in any one of 19 tumbling barrels made by the W. W. Sly Mfg. Co., Cleveland, and shown in Fig. 8, until the surfaces are clean. Then they are removed and sent to the machining department where the rings are machined on three sides; the inside being excepted, and the gaps or slots are cut. Sprues from the shakeout also are sent to the basement and are cleaned in a continuous tumbling mill made by the Sly company. The sprues cleaned from adhering sand are dumped into tared boxes, weighed and sent to the cupola where they are used in the mixture.

Careful laboratory check is maintained on sand and cupola conditions at all times. Molding sand is tested four times each day for bond strength, permeability and moisture. Four test bars are made from the cupola at regular intervals. Sulphur determinations are made four times a day; total carbon and silicon, twice and manganese, once a day.

In addition to the conveyor turntable, molds are made on 18 hand molding floors. These floors are used to produce the large size rings, and the metal is conveyed to those floors by ladles suspended from a monorail system passing in front of the large ring cupola. The sand on these floors is reconditioned with two sand mixers and blenders supplied by the Royer Foundry & Machine Co., Wilkes-Barre, Pa.

Opens New Headquarters

Norton Co., Worcester, Mass., recently opened a new district service building at 1306 East Fifty-fifth street, Cleveland. All divisions of the company for that district will have their headquarters in the new building. It is a brick and concrete structure, 100 x 140 feet, containing storage rooms, offices, a truing room and a service department. A. R. Sandine is district manager for the grinding wheel division and M. E. Mattson occupies the same position in the grinding machine division. The Cleveland Tool & Supply Co., 1427 West Sixth street, Cleveland will continue to act as agents for the Norton Co.

Unify Gray Iron Costs

Gray Iron Institute, After Year of Study and Research, Offers Standard Cost System to Industry

THE value of good cost accounting methods to any business is generally recognized by all up-to-date business men. Government investigations in many industries have shown that concerns which have adopted good cost accounting methods are much more likely to prosper than those who guess at their costs. Some of the chief advantages of a good cost accounting system are as follows: It provides an accurate basis for estimating selling prices. It eliminates guess work and the basing of quotations on competitors' prices, as reported and frequently misrepresented by buyers. It shows up profitable and unprofitable lines of work; and monthly cost reports showing variations of major cost items from former figures, or from predetermined standards, are an invaluable aid to the management in reducing costs, eliminating waste, and generally controlling the efficiency of labor and the consumption of materials.

Industry Is Benefited

The industry as a whole is benefited in many ways by a standard cost system. It provides the one best way known to the industry to figure costs.

Foundries that have no cost system but desire to install one will be provided with a correct system based on the best standard practice and experience of others, thereby eliminating expensive individual and independent experimentation. This should encourage and accelerate the adoption of accurate cost methods by many foundries that heretofore have been unable to secure such information from any source, or with any confidence that the method was standard practice.

Uniformity in cost ccounting methods can be attained only by the recognition of some one system as standard. The Gray Iron institute system is the only standard system for gray iron foundries which has organized backing. Its main features are practically identical with the best current practice now in use by the most up-to-date gray iron foundries. It will be kept up to date and revised whenever revisions prove necessary or advisable. For these reasons the institute believes it will be recognized as standard for the gray iron industry and adopted by a great majority of gray iron foundries.

Numerous disadvantages, which result from ridiculous prices based on guess work and ignorance of true production costs, will be eliminated. Foundries having similar actual costs will tend to quote approximately similar prices. Differences in price will be based on differences in efficiency of operation, instead of on differences in the method of figuring the cost. Competition will then be on a sound and legitimate basis, and the market for gray iron castings will be greatly stabilized. Buyers of castings will be inspired by a new and heretofore unknown feeling of confidence that prices quoted are based on accurate costs.

Foundries using a uniform cost system will be able to compare costs with each other with the assurance that each item of cost is figured by the same method. This fact will undoubtedly speed up the formation of local cost groups in many foundry centers. Comparative cost reports will enable each foundry to compare its major items of cost with the average and lowest costs reported by the local foundry group, thereby providing an invaluable aid in locating abnormally high items of cost and reducing them to figures which others have attained. The tendency will then be to raise the level of efficiency of the whole group, thereby enabling the foundrymen to more effectively meet competition from other districts, and from competing industries.

The following represents the standard cost system for gray iron foundries as recently adopted by the Gray Iron institute:

Standardize Costs

FOR several years leaders in the gray iron industry have pointed to the need for a uniform cost system applicable to all foundries making gray iron castings. Shortly after its organization, the Gray Iron institute appointed a cost committee to undertake the preparation of such a system. In collaboration with other foundrymen and recognized authorities on foundry cost accounting in various sections of the country, the committee has prepared a standard cost system embodying the best standard practice now in use among progressive gray iron foundries. In its simplest form, the system is designed to meet the needs of small foundries which desire the least possible clerical expense. However it is capable of expansion by further subdivision of products, departments and accounts, so that it will give any desired amount of detailed information. The first portion of the standard cost system of the Gray Iron institute is presented in this article. The cost committee of the institute is composed of the following: John L. Carter, chairman, Sacks-Barlow Foundries Inc., Newark N. J.; G. E. Finck, Bethlehem Foundry & Machine Co., Bethlehem, Pa.; Wm. J. Grede, Liberty Foundry, Inc., Wauwatosa, Wis.; A. E. Hageboeck, Frank Foundries Corp., Moline, Ill.; P. E. Rentschler, Hamilton Foundry & Machine Co., Hamilton, O.; F. C. Schimpf, Olney Foundry Co., Philadelphia; L. C. Vallier, Buffalo Foundry & Machine Co., Buffalo.

Foundry Cost Divisions

General Overhead Expense includes all the items of cost and expense not chargeable specifically to one of the manufacturing or auxiliary departments. Such expenses are: Taxes (except federal and state income taxes), insurance, depreciation, heat, light and power, general supervision, general labor, general repairs, general office expense, administrative expense, advertising and selling expense, compensation insurance, loss on bad debts.

The Four Main Productive Departments, the manufacturing departments, are the same for the simplest or the most elaborate accounting system. They are as follows:

1. Melting department.
2. Molding department.
3. Core department.

4. Cleaning and shipping department.

Any of the four main departments may be subdivided into as many classifications or divisions as desired. The following subdivisions are only suggested, as their use is entirely optional with the local foundry:

Molding Department:

2 A. Heavy floor (undercrane).

2 B. Light floor (not undercrane).

2 C. Bench.

2 D. Squeezer machines.

2 E. Jolt machines (or other heavy machines).

2 F. Throwing machines.

Core Department:

3 A. Bench.

3 B. Floor.

3 C. Machine.

Cleaning and Shipping Department:

4 A. Cleaning department (tumbling, sandblasting, pickling).

4 B. Finishing department (grinding, chipping, filing, sorting, inspecting).

4 C. Shipping department (packing, shipping).

The Auxiliary Departments are those that contribute to the proper functioning of the manufacturing or productive departments. Auxiliary departments may be used and their number and functions are optional and dependent only on the detail desired. Among the most common auxiliary departments are:

5. Carpenter shop.

6. Pattern shop.

7. Maintenance department.

8. Heat, light and power department.

Special Manufacturing, Assembly or Finish Operations, such as machine work, assembling, jappaning, plating, and annealing, are not part of the foundry operations and must be considered as separate manufacturing operations, independent of the foundry.

Definition of Departments

The Melting Department includes the cost of all metals, fuels, repairs, supplies, conversion cost. The conversion cost includes labor and power beginning with the assembling of the melting stock and the fuel at the place of storage, and ends with the delivery of the molten metal into the ladles at the spout of the cupola or furnace.

The Molding Department includes the direct molding labor, expense labor, repairs, supplies, beginning with the transportation of the molten metal from the spout, the pouring of the metal, the preparation of the molding sand, and ends with the delivery of the castings into the cleaning department.

The Core Department includes the direct core making labor, expense labor, repairs, supplies, beginning with the mixing of core sand mixtures, and ends with the delivery of the finished cores to the molding department.

The Cleaning and Shipping Department includes the direct labor and expense labor of tumbling, sandblasting, grinding, chipping, gaging, inspecting, shipping, repairs, supplies. This cost ends when the castings are delivered to the shipping platform. Deliveries by truck to local customers, or to freight car, and freight and express out are chargeable to Account 192, Trucking, Freight and Express Out.

Classification of Accounts

Method of Assigning Account Numbers

10 to 49. Regular manufacturing departments.

50 to 99. Auxiliary departments.

110 to 189. General overhead expense accounts.

200 to 299. Revenue accounts.

300 to 399. Asset accounts.

400 to 499. Liability accounts.

In the Department Accounts, 10 to 99, the first numeral identifies the department, the second identifies the nature of the charge, as follows:

0	Direct material.
1	Direct labor.
2	Indirect labor.
3-1	Fuel.
3-2	Sand and materials.
3-3	Miscellaneous supplies and tools.
4 to 6	Reserved for special items.
7	Repairs.
8	Foremen and clerks.
9	Share of general overhead.
	9-1 Fixed charges.
	9-2 Heat, light and power.
	9-3 General expense.

The following standard classification of accounts, based on the cost divisions of the foundry as herein established, is recommended for use in gray iron foundries:

1. Melting Department

10. Metals: Pig iron, iron or steel scrap, alloys, including freight, cartage and unloading.

12. Labor: All labor in melting department such as: Transporting materials to charging floor, hauling out slag and ashes, charging, patching, cupola tending, laboratory expense, yard labor, lining ladles, relining cupola, chemists, cranemen.

13-1. Fuel: All melting fuel including freight, cartage and unloading.

13-3. Miscellaneous Supplies and Tools: Flux, fire-wood, fire-brick, loam, fire-clay, fire-sand, coke forks, waste.

17. Repairs: Labor and materials used for making repairs to all equipment in the melting department.

19. Share of General Overhead:

19-1 Fixed charges.

19-2 Heat, light and power.

19-3 General expense.

2. Molding Department (System A, Procedure for Light Foundries)

21. Molding, Direct Labor (for light foundries): Molders, apprentices, helpers, rammers, finishers, core setters, and includes pouring time if pouring is done by molders or helpers.

22. Molding, Indirect Labor (for light foundries): All other labor in the molding department such as: Pouring if done by separate pouring gangs, cranemen, board wheelers, labor pouring and following heats, shakeout labor, flask fitters, sand reclaiming labor, mold-oven tenders, weight shifters, pattern carriers, tool-room labor, gagger-men, sand-mill labor, mold checkers, dry-floor laborers, sand cutter, shark pusher, facing sand mixers.

23-2. Molding Sand (for light foundries): Cost of molding sand including freight, cartage, and unloading.

23-3. Miscellaneous Supplies and Tools (for light foundries): Plumbago, brick, fuel for dry sand ovens, fuel to dry pit molds, nails, bar iron and steel, sea coal, lubricants, waste, air hose and fittings, electric bulbs, bolts, gaggers, fire clay, other compounds used in molding sand mixtures, facing, clamps, shovels, riddles, brushes, lumber, rammers and rammer butts, tools, parting.

25. Flasks (for light foundries): Labor and materials used for making, altering, or repairing wood or iron flasks, bottom boards, plates, squeeze boards, bands, jackets, etc., which are not charged direct to customer. Whenever possible the cost of special equipment should be charged direct to the customer.

26. Patterns (for light foundries): All patternmaking labor and materials for making altering or repairing patterns, mounting on boards, plates, etc., which are not charged direct to customer. Whenever possible the cost of equipment should be charged direct to the customer.

27. Repairs (for light foundries): Labor and materials used for making repairs to all equipment in the molding department (except flasks and patterns).

28. Foremen and Clerks (for light foundries).

29. Share of General Overhead (for light foundries):

29-1 Fixed charges.

29-2 Heat, light and power.

29-3 General expense.

This is the first of a series of articles presenting the standard cost system prepared by the cost committee of the Gray Iron institute. The next installment will appear in the Feb. 1 issue.

The Editors

Compares Properties of Various ALLOY STEEL CASTINGS

By David Zuege

DATA given in the previous tables are sufficient to demonstrate what can be expected from 1.20 to 1.60 per cent manganese cast steel. These data in conjunction with results of other investigators, show its superiority over plain carbon steels in the normalized, annealed and oil quenched condition. However, when a liquid quench is used the steels classified in this paper under the second subgroup give better results at the higher hardness values.

Hardens Steel

Chromium, especially when in combination with nickel, imparts marked hardening properties to the steel. It is a satisfactory alloying element and most of the alloy castings which must be heat treated individually contain an appreciable amount of chromium either alone or in combination with other alloying elements. This is due to its remarkable hardening and strengthening power and to the fact that its cost is relatively low. Cast steels having a carbon range of 0.35 to 0.45 per cent and a chromium range of 0.75 to 1.00 per cent have given excellent service after suitable heat treatment. That type casting is adaptable where abrasion resistance is required, as in tractor shoes and wearing plates.

Alloy Steels

PHYSICAL characteristics of various alloy steels for casting purposes are compared in this article, which is the second of two abstracted from a paper presented at the Chicago convention of the American Foundrymen's association, April 8 to 11, 1929. The author shows the reaction of the different steels to various heat treatments and draws conclusions from the results. Micrographs accompanying the data show the effect of alloys on the structure of the steels. The agreement between the structure and the properties also is explained. The author is research engineer, Sivyer Steel Casting Co., Milwaukee.

In the normalized and drawn condition, it develops strength values about equal to the 1.20 to 1.60 per cent manganese carbon steel but is not as ductile as a comparison of Tables II and V will show. Table V shows the values obtained on eight average heats taken from the laboratory record. Table VI shows the effect of various heat treatments upon a typical heat of chrome steel.

The addition of a second alloying element to a chrome steel affects the steel not only through the beneficial characteristics of the added alloying elements itself but also because it intensifies the hardening effects of the chromium. The most important and widely used cast chromium steels are those containing various percentages of nickel.

Compares Various Steels

Table VII is a record of the physical properties of eight routine chrome nickel heats, and Table VIII shows the effect of heat treatment upon the tensile properties of a typical heat of chrome nickel cast steel. Table XI gives the effect of heat treatment on the physical properties, including endurance limit of a second heat of chrome nickel steel having slightly lower chrome and nickel content than the heat recorded in Table VIII. Fig. 5 shows the endurance limit curves.

A comparison of the results in Tables V and VI with those in Tables

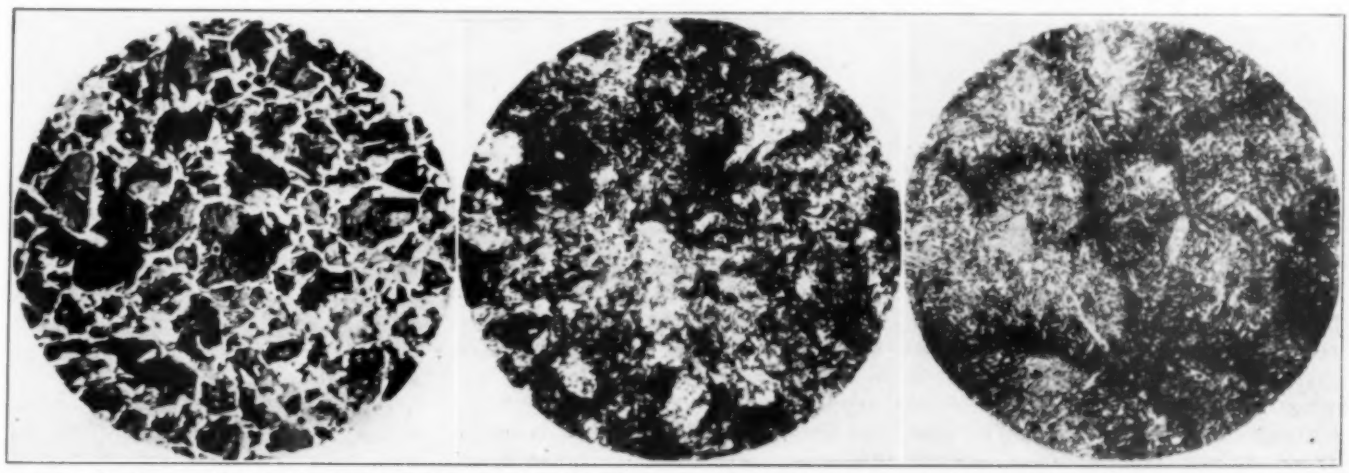


FIG. 4—LEFT TO RIGHT, 1.20 TO 1.60 MANGANESE CARBON STEEL, CHROME NICKEL STEEL AND MANGANESE, CHROME, NICKEL MOLYBDENUM STEEL, ETCHED IN 2 PER CENT NITRIC ACID, x 100

Table V

Normalized and Drawn Chrome Steel

Heat. No.	C.	Mn.	Si.	Cr.	Yield point, lbs. per sq. in.	Tensile strength, lbs. per sq. in.	Elongation in 2", %	Reduction of area, %	Brinell hardness
1	0.43	0.76	0.35	0.78	58,400	99,150	15	23.5	217
2	0.38	0.74	0.50	0.81	54,650	97,000	19	30	217
3	0.35	0.67	0.37	0.77	56,000	97,050	17.5	26	207
4	0.42	0.74	0.40	0.94	51,000	91,400	18	25.5	212
5	0.38	0.79	0.36	0.90	57,250	95,050	15	18	223
6	0.34	0.71	0.40	0.77	51,300	90,000	20	36.5	223
7	0.38	0.82	0.40	0.80	53,600	93,400	18.5	26	217
8	0.45	0.82	0.50	0.68	54,500	95,750	18	26	201

Heat treatment: Held at 1650° F. for three hours in shop electric furnace; cooled in air on annealing car; drawn at 1250° F. Size of coupons, 1" x 1" x 6".
Analysis: C., 0.35-0.45; Cr., 0.75-1.00

Table VI

Heat Treatments of Chrome Steel

Bar No.	Quench Temp., ° F.	Quench medium	Draw Temp., ° F.	Yield point, lbs., per sq. in.	Tensile strength, lbs. per sq. in.	Elongation in 2", %	Reduction of area, %	Brinell hardness
1	1550	Air	None	74,400	120,800	8.5	12.6	241
2	1550	Air	700	77,850	122,600	13.5	20	228
3	1550	Air	1200	67,150	110,850	17	25	217
5	1550	Oil	700	156,350	193,600	3.5	3.5	418
9	1550	Oil	900	143,250	163,650	8.5	14.1	340
12	1550	Oil	1200	90,200	120,450	16	35.7	241
13	1550	Oil	1350	73,300	100,000	19.5	40.4	207

Analysis: C., 0.39; Mn., 0.84; Si., 0.48; Cr., 0.79. All coupons were given a preliminary normalizing treatment at 1650° F. Size of coupons, ¾" dia. x 6".

Table VII

Normalized and Drawn Alloy Steel

(Chrome, Nickel)

Heat No.	C.	Mn.	Si.	Cr.	Ni.	Yield point, lbs. per sq. in.	Tensile strength, lbs. per sq. in.	Elongation in 2", %	Reduction of area, %	Brinell hardness
1	0.46	0.80	0.48	0.95	1.29	62,000	101,000	20	55.5	235
2	0.37	0.76	0.39	0.98	1.33	66,450	104,250	22.5	42	222
3	0.38	0.69	0.49	0.94	1.22	66,300	103,200	18	34	217
4	0.42	0.77	0.41	0.89	1.28	68,200	100,000	17.5	36	217
5	0.41	0.78	0.36	0.85	1.27	66,450	99,800	14	16.5	222
6	0.42	0.77	0.46	0.85	1.28	70,000	107,350	21	34.5	222
7	0.45	0.62	0.44	0.85	1.27	64,150	106,400	20.5	37.5	228
8	0.40	0.77	0.56	0.85	1.50	70,400	110,500	20.5	33.5	235

Heat treatment: Held at 1650° F. for three hours in shop annealing furnace; cooled in air on annealing car; drawn at 1250° F. Size of coupons, 1" x 1" x 6".
Analysis: C., 0.40-0.50; Cr., 0.75-1.00; Ni., 1.20-1.50.

Table VIII

Physical Properties of Chrome-Nickel Steel

Bar No.	Quench Temp., ° F.	Quench medium	Draw Temp., ° F.	Yield point, lbs. per sq. in.	Tensile strength, lbs. per sq. in.	Elongation in 2", %	Reduction of area, %	Brinell hardness
1	1550	Air	.....	149,950	174,050	2.5	4.3	364
2	1550	Air	700	119,200	157,900	9	22.3	321
3	1550	Air	1200	88,250	117,950	18	43	241
4	1550	Oil	700	173,300	202,350	6	11.1	487
5	1550	Oil	900	149,000	182,950	8.5	18.4	387
6	1550	Oil	1200	105,680	125,250	17.5	38.8	269
7	1550	Oil	1350	79,800	108,050	24	49.8	217

Analysis: C., 0.48; Mn., 0.70; Si., 0.45; Cr., 0.80; Ni., 1.24. All coupons were given a preliminary normalizing treatment at 1650° F. Size of coupon ¾" dia. x 6".

VII and VIII shows the superiority of the chrome nickel steel over the chrome steel under every type of heat treatment used. Since the analyses given are typical of those used in many foundries making chrome nickel castings, this analysis may be used as a typical representative of the steels of the second subgroup for comparison with the properties of the first.

Referring to Tables II, IV, VII, and IX, it may be noted that the normalized and drawn chrome nickel steel has slightly higher values for yield point and tensile strength than the normalized manganese carbon steel, but also has considerably less ductility. Difference between these steels is not as great with the usual foundry heat treatments as when a more drastic quench is used. More rapid quenching emphasizes the hardening and strengthening effects of the chromium and nickel so that at the higher hardness values the chrome nickel steel is a better steel. Note that for charpy impact values of 2.8 and 3.1 foot pounds respectively, the manganese carbon and chrome nickel steels show 144,300 and 184,250 pounds per square inch tensile strength. Not only does the chrome nickel steel have greater ductility than the manganese carbon steel through the top portion of the brinell range to which it is possible to harden the manganese carbon steel, but it is capable of being hardened to a much higher brinell value.

Compares Properties

Manganese carbon steel usually is used in those cases where moderately high strength values accompanied by excellent ductility are required. Chrome nickel steel does not show markedly better properties than the less costly manganese carbon steel when both are given the usual type of foundry heat treatment. The distinct advantage of the chrome nickel steel is that its properties may be improved by proper heat treatment of individual castings to a far greater degree than is possible with the manganese carbon steel.

Strains are set up in chrome nickel steel castings by rapid cooling action which may crack the castings before the strain has been relieved by the drawing operation. In any castings where quenching is resorted to for development of maximum physical properties, the design should be such as to minimize strains. Abrupt changes in section and sharp corners should be avoided.

Whenever exceptional properties are required in castings of intricate design, a steel having air hardening properties is desirable. Because of the strains set up by rapid cooling of castings of complicated design or abrupt change in section, it is impossible at times to liquid quench castings of the type included in the third subgroup. The element molybdenum imparts air hardening properties, especially when in combination with another hardening element, and it is considered as the characteristic constituent of air hardening cast steels. Molybdenum alloy cast steels are being made in a variety of analyses. A popular one is 0.40 to 0.60 per cent carbon and 0.25 to 0.35 per cent molybdenum in combination with chromium.

Although the use of molybdenum in cast steel is increasing, few data have been published giving physical properties which may be obtained from these steels. The author has

investigated the properties of various types of molybdenum steels and, although endurance limit tests have not been completed, the results obtained for other properties show that certain combinations containing molybdenum will develop exceptional values.

As a special representative of this group a chrome nickel molybdenum manganese combination has been selected and Table IX gives the properties obtained on each of four heats of this material under five different heat treatments. Note that the carbon content has a decided influence on the air hardening properties as shown by the brinell values in Table IX, heat treatment A.

Has High Physical Properties

With a carbon content of 0.34 to 0.42 per cent, an air quench followed by a 700 degree Fahr. draw produced tensile strength values over 200,000 pounds per square inch, yield point over 160,000 pounds per square inch, and minimum elongation and reduction of area values of 10 per cent and 28.9 per cent respectively. Increasing the draw to 1250 degrees Fahr. gave the following minimum for the same carbon range: Yield point, 90,000 pounds per square inch; tensile strength 119,000 pounds per square inch; elongation, 19.5 per cent; reduction of area, 40.1 per cent. The impact values are also very high, 20.1 being the minimum.

Table X, which tabulates hardness data, shows that with drawing temperatures as high as 1000 degrees Fahr. considerable hardness is maintained, even though only an air quench is given. This enables strains to be removed from intricate castings. without sacrificing hardness to too great an extent.

In comparing the results of the typical heats for the three groups, all of which have been made in the acid electric furnace and which have received degasifying additions in sufficient quantity to prevent objectionable porosity in green sand molds, Tables IV, IX and XI show the following:

When normalized at 1650 degrees Fahr. and drawn at 1275 degrees Fahr., the molybdenum steel has markedly better all around properties than either the manganese carbon or chrome nickel steels. Its superiority is greatest in yield point and charpy impact values.

The molybdenum containing steel has exceptional air hardening properties. A simple air quench and draw treatment develops properties equal to and in many instances superior to those obtained by a liquid quench on the other types.

Table IX

Physical Properties of Cast Alloy Steel

(Manganese, Chrome, Nickel, Molybdenum)

Heat No.	Carbon %	Brinell	Yield point, lbs. per sq. in.	Tensile strength, lbs. per sq. in.	Elongation in 2" %	Reduction of area, %	Charpy impact ft. lbs.
Held at 1650° F. two hours; air quenched; drawn at 700° F.							
3	0.28	364	145,850	174,350	11.5	30.9	2.6
		364	151,500	175,950	11.5	34.7	2.6
9	0.28	340	112,300	159,250	13	41	2.3
		340	114,200	161,050	13.5	40	10.3
6	0.34	477	174,750	238,000	10	30.5	3.1
		477	176,000	242,000	8.5	28.9	3.1
12	0.42	430	160,300	206,200	10	31.5	3.1
		430	173,150	204,350	10	31.5	2.8
Held at 1650° F. two hours; air quenched; drawn at 1000° F.							
3	0.28	364	112,300	164,050	13.5	32.8	8.1
		364	125,000	163,350	13.5	29.5	5.8
9	0.28	340	116,700	153,300	15.5	35.4	8.1
		340	116,000	153,750	15.5	36.8	7.9
6	0.34	387	145,750	177,000	13.5	35	9.2
		387	139,000	174,650	13.5	38.1	9.6
12	0.42	402	148,750	179,150	15.5	37	7.3
		402	143,300	176,000	13.5	35.4	7.3
Held at 1650° F. two hours; air quenched; drawn at 1250° F.							
3	0.28	255	90,400	119,350	22.5	53.3	23.3
		255	86,750	118,100	23	51.9	22.2
9	0.28	241	81,750	111,750	22	51.5	19
		241	80,600	111,400	23	51.7	17.7
6	0.34	269	90,900	123,450	23	51.7	20.1
		269	93,250	123,650	22.5	50.6	21.7
12	0.42	269	91,100	119,200	19.5	40.1	23.8
		269	90,550	119,700	19.5	45.4	23.2
Held at 1650° F. two hours, air quenched; held at 1550° F. two hours, oil quenched; drawn at 1000° F.							
3	0.28	402	167,000	181,450	13	36.6	11.4
		402	176,700	182,700	12.5	32.1	10.3
9	0.28	418	171,750	181,150	15.5	44	11.4
		418	171,850	183,350	15.5	45.2	12.1
6	0.34	418	173,750	197,100	11	25.4	8.1
		418	169,500	194,600	11	22.7	7.6
12	0.42	418	171,000	193,000	11	27.2	7.1
		418	168,600	192,400	10.5	23.4	8.1
Held at 1650° F. two hours, air quenched; held at 1550° F. two hours, oil quenched; drawn at 1250° F.							
3	0.28	255	93,900	120,200	22.5	48.4	22.5
		255	91,000	117,700	21.5	48.1	19
9	0.28	255	81,100	114,050	25	53.8	25.8
		255	75,850	114,300	24	53.3	24.5
6	0.34	269	92,350	126,500	21.5	42.8	23.2
		269	103,500	125,000	17.5	48.6	19
12	0.42	269	93,000	121,950	21.5	39.1	20.5
		269	94,500	127,650	17	33.7	21.7

Size of coupon, 1" x 1" x 6".

Table X

Brinell Hardness of Cast Alloy Steel

(Manganese, Chrome, Nickel, Molybdenum)

Heat No.	Quench in air at 1650° F. — No draw (Av. of 6)	Draw at 700° F. (Av. of 2)	Draw at 1000° F. (Av. of 2)	Draw at 1250° F. (Av. of 2)	Air quench at 1650° F.; then oil quench at 1550° F. — No draw (Av. of 4)	Draw at 1000° F. (Av. of 2)	Draw at 1250° F. (Av. of 2)
3	387	364	364	255	504	402	262
6	514	477	387	269	555	418	269
9	331	340	340	241	512	418	255
12	461	430	430	269	555	418	269

Size of coupon, 1" x 1" x 6".

When liquid quenching is employed to obtain high hardness values, the molybdenum steel is superior to the chrome nickel, which in turn is better than the manganese carbon steel.

Molybdenum steel has greater hardening possibilities, and for any definite fairly high hardness value has greater toughness and ductility than the chrome nickel.

Fig. 4 shows specimens taken from bars whose values are shown in Tables IV IX and XI. Each bar has been normalized at 1650 degrees Fahr. and drawn at 1250 to 1275 degrees Fahr. The ferrite in the manganese carbon specimen has separated to the grain boundaries; in the nickel chromium, it has started to segregate into irregular areas, and in the steel containing molybdenum little ferrite segregation has occurred. This is in accordance with the hardness and yield point values of the various steels.

Although micrographs of the oil

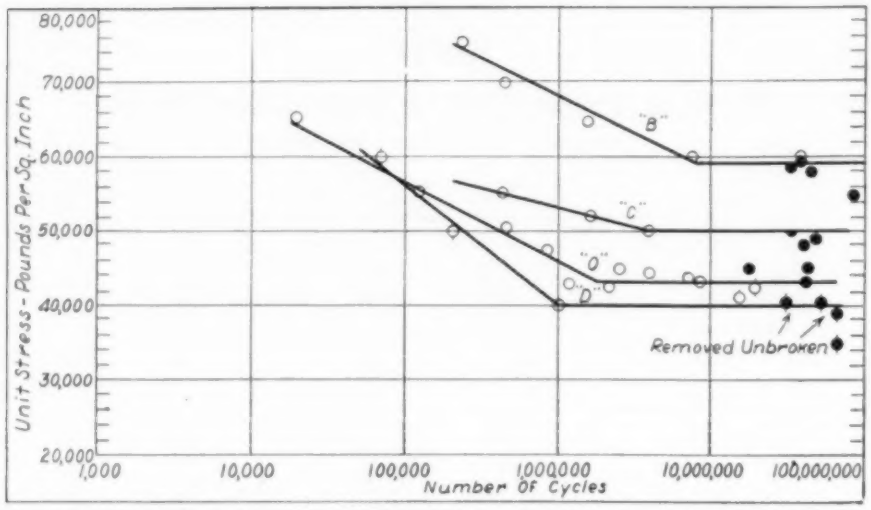


FIG. 5—ENDURANCE LIMIT CURVES FOR STEEL OF TABLE XI, HEAT TREATMENTS *O, B, C,* AND *D*

quenched specimens show far greater structural refinement, in this paper only those micrographs are shown which show the typical structure obtained under the treatment most often used commercially in the foundry for alloy steels, i. e., normalized and drawn.

The manufacturing cost of the steels of the three groups increases progressively from the first through the last. This is due not only to the cost of the additional alloying elements, but also to the fact that as the hardening tendencies increase, greater care must be used in molding and cleaning room practices. The steels of the second and third groups are usually tender, in the cast condition, are susceptible to cracks and breakage and, because of their hardening properties, are difficult to grind and chip. They often require a preliminary heat treatment before they are sent to the cleaning room. Hence, the proportional cost increase for the high alloy steels is greater than the actual increase in cost of alloys used.

These data have been presented by the author to supplement information contributed by other investigators relating to alloy steel adaptable to castings. The interest the subject holds for many producers and consumers makes advisable free interchange and broad publication of reliable information on the subject. The author believes that those who make common or carbon steel castings and those who manufacture special or alloy steel castings will promote the profitable and otherwise satisfactory distribution of their products only as these producers make available, accurate information showing typical properties.

Selection of the steel to be employed involves economics, which is outside the scope of this article, except as it may now be touched upon in closure. It has been indicated that the manufacturing costs of the steels described increase in the same relative order as do their physical properties. Heat treatment costs must be considered as well as metal, molding, and other items of expense incurred prior to the final forming of the casting. Machining costs must not be disregarded, although it should be appreciated by consumers that as the toughness of a metal is increased, the latter necessarily offers more resistance to many kinds of punishment. Maximum toughness and minimum mechanical effort in machining appear to be incompatible.

It seems worth while, in speaking of durability, to mention the all-important fact that in a sense peculiar to the foundry, the chemical composition of the material of which the product is made is by no means conclusive evidence of the serviceability of the manufactured piece. The extent to which this applies becomes greater as we leave the field of common or carbon steels, and extend our study to alloy steels. A great many details of foundry technique quite apart from the satisfactory manufacture of the metal in the furnace are involved in the production of alloy steel castings that will render satisfactory service. Certain alloying elements have peculiar characteristics that must be taken into consideration in numerous operations essential to casting manufacture. As the production of alloy cast steels increases proportionately in any shop, experience is acquired that has an inevitable and invaluable influence on the satisfactory performance of the product.

Reference made to chemical composition as being no more than one of several important factors makes it appropriate to mention the fact, appreciated by foundrymen but not always understood by consumers, that the behavior of the metal in a laboratory specimen may be far different from that of the same steel in a member of a casting, due to many possible causes, one of which is design.

The bureau of standards recently has published two bulletins relating to fireclay bricks and fireclays, and to metallographic polishing. The first bulletin is entitled, "Progress Report on Investigation of Fireclay Bricks and the Clays Used in Thier Preparation," by R. A. Heindl and W. L. Prendergast. The other is, "Metallographic Polishing," by S. Epstein and J. P. Buckley. These bulletins are priced at 15 cents and 10 cents respectively.

Table XI

Heat Treatments of Chrome-Nickel Steel

Heat treatment	Yield point, lbs. per sq. in.	Tensile strength, lbs. per sq. in.	Elongation in 2", %	Reduction in area, %	Brinell hardness	Sclero-scope hardness	Charpy impact ft. lbs.	Endurance limit lbs. per sq. in.
O	65,800	115,750	18.5	28.9	217	35-37	8.6	43,000
	60,380	114,000	19.5	30.5	217		8.3	43,000
A	Bars not machinable.				512			
B	170,350	184,250	8.5	17	364	52-58	3.1	59,000
	174,000	186,100	7.5	13.4	364		3.1	
C	88,450	107,800	24.5	48.6	255	45-50	10.9	50,000
	89,350	108,000	27.5	47.8	269		9.8	
D	79,100	103,300	27	49.2	197	28-35	18.3	40,000
	82,650	103,800	26.5	50	197		14.8	

Heat Treaments

O normalized at 1650° F. (two hours' soak); drawn three hours at 1250° F.
A normalized at 1650° F. (two hours' soak). Held two hours at 1550° F.; quenched in oil; drawn at 600° F.
B normalized at 1650° F. (two hours' soak). Held two hours at 1550° F.; quenched in oil; drawn at 900° F.
C normalized at 1650° F. (two hours' soak). Held two hours at 1550° F.; quenched in oil; drawn at 1200° F.
D normalized at 1650° F. (two hours' soak). Held two hours at 1550° F.; quenched in oil; drawn at 1350° F.

Analysis: C., 0.48; Mn., 0.70; Si., 0.45; Cr., 0.80; Ni., 124. Size of coupon, 1" x 1" x 6".

Co-operation Brings Better Pattern Equipment

Castings Buyers May Secure a Better Product At a Lower Price by Consulting with the Foundryman

By J. D. JUDGE
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Hamilton, O.

TRADITION, custom, or convenience has divided the foundry industry into three branches in accordance with the type of castings produced. Although there exists no definite lines of demarcation between the light, medium and heavy branches, there are sound reasons for the maintenance of these classifications. While it is true that each branch springs from a common root, it is equally true that each division has developed characteristics common to itself. Patterns and pattern equipment, although fulfilling the same mission in both the light and the heavy shop, differ radically in design and use. Obviously then any discussion of pattern equipment should differentiate between the light, the medium, and the heavy. The remarks that follow are written from the viewpoint of a jobbing foundry, specializing in the production of small, light castings on a quantity basis.

A pattern, in foundry terminology refers to that form of equipment used for the production of castings with identical configuration. It follows from this, that the quality of the pattern has a decided influence upon the quality of the resulting casting. Although it is conceivable that a poor molder may turn out an inferior casting from a first-class pattern, nevertheless the assumption that a good mechanic can make up for deficiencies in the pattern, is without sound basis. Quality, then, is essential. However, with the vast majority of patterns, quality must be supplemented by suitable design. Pattern design naturally is of importance because of its relationship to casting cost. A pattern of unquestionable quality and embodying the finest type of design, offers of itself an incomplete solution to the problem of economic production. The additional requirements, equal in importance with those already mentioned, are included for want of a better word, under the term *equipment*. An all-inclusive word embodying an infinite variety of meanings, equipment may be briefly and broadly defined as all items, tangible or intangible, which must be added to a pattern for the economic production of castings.

Three Essentials

Quality, design and suitable equipment are the essentials of good patterns.

The necessity of building and maintaining patterns of high quality, generally is appreciated by those charged with this responsibility. The futility of attempting to use wooden patterns instead of the more expensive metal equipment on production jobs, soon becomes all too apparent in the quality of castings produced. Major changes or continued minor operations, even on the best metal equipment, invariably reach a point where the interests of both quality and economy are best served with entirely new patterns. These and similar facts exemplifying the benefits derived from quality patterns, is common knowledge among foundrymen, and to them the need for an expansive treatment of the subject is unnecessary.

Pattern design, because of its importance, merits serious consideration. In general, design, like quality, is accorded important rank by most concerns engaged in the purchase of castings. Individual designers or staffs of such experts, depending upon the size of the concern, form an essential department of such organizations, and these men usually are well grounded in the fundamentals of foundry practice. Accordingly, they are qualified to develop practical designs, judged by foundry standards. However, many users of castings are not so well provided and in such cases it is the foundryman's duty to do all he possiby can to educate them along the proper lines.

Practical pattern design embodies such familiar considerations as the necessity for draft, the avoidance of radically different sectional areas, the importance of properly proportioned metal walls, the advantage of eliminating cores wherever possible, the equal advantage of inserting cores when good practice demands such action, and numerous other items of a more complex character.

However, there are numerous concerns, where the services of a skilled pattern designer are not available. In such cases, when the question of proper procedure arises, it is customary for some individual to exercise his best judgment which frequently means the assumption of a play safe attitude. An example of this type is well portrayed in Fig. 1. A cuttomer was in the market for some small washer castings, approximately ¾-inch in diameter, ¼-inch thick, and with a ¼-inch diameter hole extending through the castings. Evidently the question must

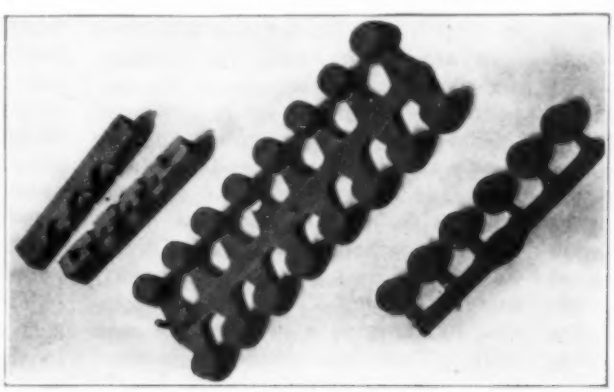


FIG. 1—SUBSTITUTION OF A GREEN SAND CORE REDUCES THE COST

have been advanced as to whether or not the holes could be made in green sand. Someone presumably decided, from his limited experience, that such precedure was not practical, and a play safe policy was designed for use with a dry sand core and the equipment was forwarded to the foundry. The original pattern and core box are shown in the center and at the right in the cut.

The foundry questioned the need for the dry sand core immediately upon receipt of the equipment. Correspondence with the customer, elicited the information that a small amount of draft in the hole would in no way be objectionable. The foundry then obtained an order from the customer for new patterns for green sand molding. These patterns were used on all future orders, with complete satisfaction to both the customer and the foundry. (For illustrative purposes a few of these patterns were soldered temporarily to a runner, and are shown at the left in Fig. 1.) The customer in this case received a casting of superior appearance, and at a lower cost than it would have been possible to produce from the equipment which he originally submitted.

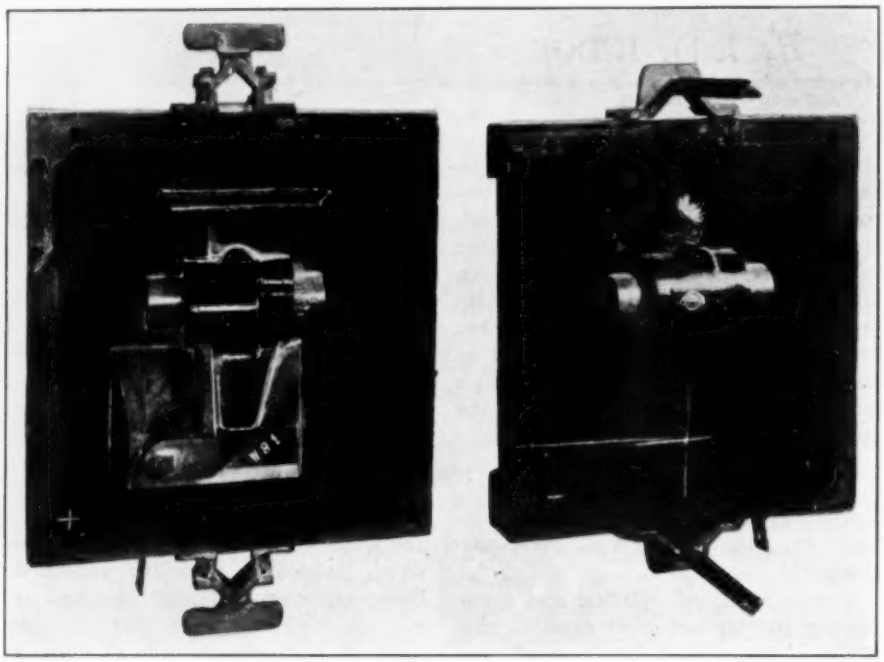


FIG. 2—HEAVY SHOP CHARACTERS ARE APPARENT IN THIS PATTERN EQUIPMENT FOR A LIGHT CASTING

As a matter of fact, the saving on the first order more than paid for the new pattern equipment. The unfortunate phase of this situation was, of course, the loss entailed in the preparation of the original patterns and core box. This example serves to illustrate the fact that high-grade patterns, even when spaced and gated in the most approved manner, are of little value in the absence of good design.

The ordinary problems of pattern design such as the one just described, present little difficulty to an experienced designer. However, problems frequently develop which necessitate the balancing of one set of conditions against another. A high degree of judgment is demanded from even the best designers under such circumstances.

Thin sectional castings, such as bases, covers, hoods, boxes, etc., afford good examples of this fact. In such castings the metal thickness is an important item because of its effect on the total weight. Casting weight must be considered because of the influence it exerts upon the handling costs during the manufacturing process; because of its effect on transportation costs during the distribution of the final product; and, finally, because of the limiting factors frequently imposed by assembly into readily movable units. The foundry must also be included in these considerations.

In any specific case, the foundryman knows from experience the approximate minimum limit of metal thickness for practical production. He is able to produce castings beyond this limit, but being mindful of the hazards, in the way of abnormal losses, which invariably attend such departures from good practice, he properly protects himself from all contingencies, by charging a premium for such work. These and similar facts must be considered conscientiously in the design of any pattern if maximum economy is to be realized in the castings produced from the pattern.

Another rather perplexing problem of pattern design is the degree of complexity advisable. It is quite possible that the production of two simple castings, even with the additional machining or grinding, and assembly costs might prove more economical than the production of a single, complex casting. A simple casting as compared with one of a more complicated nature always has the advantage of a more rapid rate of production by a less skilled type of labor with corresponding reduction in cost.

Cores Influence Cost

Cores enter largely into any discussion of pattern design. The introduction of cores in the design of a pattern almost invariably means a higher priced casting. Moreover, if the core is to be placed on an exterior surface, fins and a variation in surface texture usually are in evidence, although this fact may or may not be of importance. The practice of using cores for lightening purposes is at times open to question. In many cases it is economical to eliminate the cores and allow the additional metal to remain. Although there are exceptions, cores generally should only be incorporated in pattern design when their presence will make possible a more practical means of production. In all cases where cores are required, just as much thought should be given to the design of the core boxes as is ordinarily accorded to the patterns.

The fact has been previously mentioned that a pattern of itself possesses only potential possibilities and that equipment is required to transform it into a producing unit. Because of this fact equipment assumes equal rank with quality and design. The ordinary intangible items included in the term equipment are design of combinations rather than individual patterns, planning, layout, etc. The more common tangible items are the duplication of identical patterns, or the combination of similar patterns for full mold production, gating for hand or squeezer work, mounting for either match plate or heavy machine production, etc. Pattern departments of foundries or jobbing pattern shops generally are held responsible for, and ordinarily are qualified to produce suitable pattern equipment. Exceptions to this generalization even though they are relatively few in number, are of interest.

It is customary for plants engaged in the fabrication of heavy castings to operate their own foundry and to maintain their own pattern shop. Small castings are always needed by

such plants, and it is frequently found desirable to send patterns to foundries, specializing in that light class of work. This policy is economically sound and is to be commended. Often, however, a goodly portion of the advantage which should accrue to the purchaser is lost because of the type of pattern equipment furnished to the light foundry. Pattern equipment for small castings, originating in a pattern department devoted almost exclusively to heavy work, almost always will display heavy pattern characteristics.

Shows Heavy Characteristics

An example of this kind is the bracket pattern shown in Fig. 2. The pattern is split into two parts and a large core print is included to provide a *flat back* for the job. This is a common method of designing patterns of this kind, and is entirely satisfactory when the production requirements are small. However, in the present case, fairly large quantities of castings were required. Since the customer refused to change the design of the equipment, and since it was uneconomical from a production and labor viewpoint to run the loose, split pattern, as received, it seemed advisable to mount the two parts on boards as shown. This arrangement being more or less makeshift in character, naturally was reflected in the price of the castings. Had the customer redesigned this equipment, an appreciable reduction of this price would have been realized. Redesigning in this case would have meant either a cast aluminum match plate, or metal patterns designed for use with a hard sand match. The large block core could thus be eliminated entirely, and a gate of two patterns could have been arranged in a slightly larger flask.

Spacing, particularly when a number of small patterns are combined to form a mold, is another item of importance. Patternmakers who have been accustomed to work with heavy sections, usually are too liberal with the space that they allow between small patterns. Others, of course, also possess this same trait. Spacing, arrangement, gating, mold size, etc., all are factors effecting the ultimate cost of castings. It is a simple matter to lose all benefits which should be derived from good, individual patterns, by disregarding any of these items.

The center illustration in **Fig. 3** is an example of inefficient spacing and arrangement. Two gates of similar patterns, properly spaced, are arranged at each side for comparison. From these illustrations the wastefulness of the design of the central equipment must be apparent.

Often, particularly with the development of a new machine, several small castings of similar design are required. It sometimes is customary in cases such as this to produce full mold equipment for each of the castings. Such equipment naturally is very acceptable to the foundry. However, a combination of several of these patterns in one mold frequently proves more economical, although not as desirable to the foundry because of the problem of uneven scrap losses, and the difficulty of balancing orders. Procedure of this nature is advantageous to the customer, assuming, of course, that the production requirements during the initial stages of manufacturing are slight, because it decreases his pattern equipment investment, and because it materially reduces expense when the numerous pattern changes, which invariably occur in cases of this kind, take place. As soon as the design of each particular part is definitely established, full mold equipment should be provided.

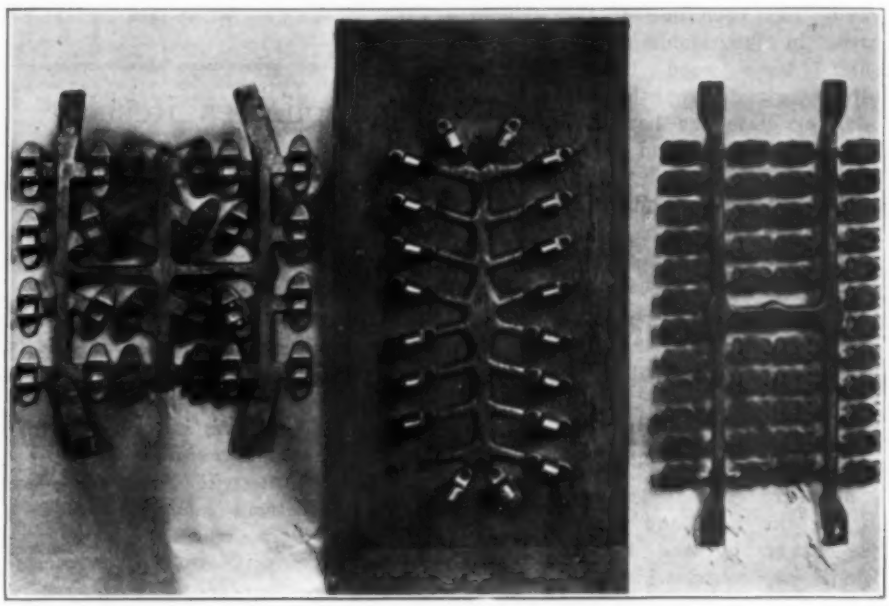


FIG. 3—SPACING ARRANGEMENT AND GATING ARE IMPORTANT CONSIDERATIONS

The examples that have been shown and discussed indicate that a constant need exists for data on the proper design of patterns. They emphasize the opportunity afforded for the elimination of waste in industry. The development of a more helpful spirit of co-operation between buyers and sellers of castings would go far toward lessening waste.

The foundry, as the seller of castings, is in a position to do much toward the betterment of the industry as a whole. Needless to state, it is essential that the foundry maintain a highly dependable cost system. Facts derived from such figures are indispensable, if the foundry is to be qualified fully to present figures for any variation in design in which the buyer may be interested. A willingness to offer suggestions or advice, or to present figures should be manifest at all times. Furthermore, a policy of broadcasting information of an instructive and educational nature should be fostered. Such information can be of benefit to the buyer and also to other sellers in the industry. In this connection it is well to call attention to the good work being accomplished by national, state, and local groups of foundries. Such agencies reap the benefit of united effort, which should appeal to all. It is almost proverbial that any movement, which tends towards the improvement of an industry as a whole, redounds to the betterment of the individuals of that industry.

The buyer of castings also plays an important part in the scheme of general betterment. He can effect economies by availing himself of published information on pattern equipment and similar subjects. The buyer should feel free at all times to discuss his problems with the foundry. Questions relative to design of equipment often can be decided most satisfactorily by consultation between the buyer and the seller. Purchasers of castings must look upon the expenditure of goodly sums of money for pattern equipment not as an expense, but rather as an investment which will yield returns in the form of better castings at a lower cost.

Screen Analysis

Determines Distribution of Sand Grains

By W. W. KERLIN

EVER since castings have been made, mixing and blending the sand which forms the mold cavity has been one of the principal cares in the molder's art. Certain sands have good heat resistance, others give strength while others open or close the heaps. Sometimes a heap will go dead and it is then that the foundryman relies upon his experience with sands to bring the heap back into shape. On approaching a foundry sand problem from a scientific angle we enter by way of the laboratory and find there are four tests which sand control men rely upon. They are: 1. Moisture content; 2. Permeability; 3. Bond, and 4. Screen analysis.

Measures Venting Properties

Moisture content is determined by drying the sand and determining the percentage by the loss in weight. Limits are found which give best results then moisture is kept in this range. Usually it is desirable to have a sand which shows uniform physical properties over a wide moisture range. We then have a sand that tempers well and retains its best physical properties while the mold is being closed and poured.

Permeability is based on the volume of air per minute that will pass through a plug of sand 2 inches long and 2 inches in diameter. This is a direct measure of the venting properties of the mold. It also indicates whether the sand is too open to produce the smooth surface required for certain work. Its relation to moisture content is shown by the permeability varying with the percentage of moisture. Here again a constant permeability over a wide moisture range indicates a sand which has a stable tempering range.

Bond is determined by a number of methods. The oldest is by the feel of the hand when the sand is tempered. Another is the method developed by Eugene Smith which consists in shaking up the sand with water in a bottle and computing the percentage of bond by volume by measuring the deposit of loam after the rest has settled. Many take the shear strength as a function of the bond content. The most precise method is by actually washing out the clay matter and computing percentage by loss of weight when the residue is dried. Bond not only has a direct bearing on strength of the mold but also has an effect on the permeability and the temper of the sand. This will be discussed further when the grain size and bond distribution are considered.

Duplicates Results

SAND control is of interest to all foundrymen as it enables them to eliminate foundry losses from that source. However, before sand control can become a reality, a firm foundation must be established. For this purpose, the screen test will be found of great assistance since it enables the foundryman to determine the grain characteristics of the sand he finds most suitable. At any later time he will be able to duplicate the results by blending his sands. This article is abstracted from a paper presented at a recent meeting of the Pittsburgh Foundrymen's association. The author is research chemist, Enterprise Sand Co., Pittsburgh.

The fourth test useful in the examination of a molding sand is the screen analysis of the grain residue from the bond determination. This gives the base grain distribution of the molding sand. I consider this to be one of the factors which is most important in determining the effect of moisture, permeability and bond on the quality of the molding sand. It is a subject which has not been considered much in the literature.

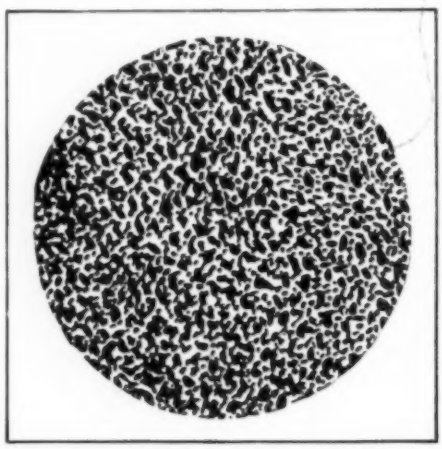
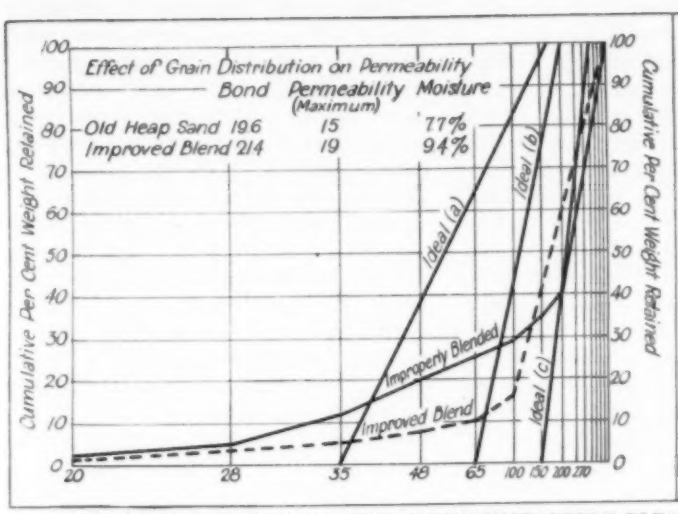


FIG. 1—PEN SKETCH OF SAND SURFACE PRESENTED TO IRON

Uses Standard Screen Scale

A clear method of representing base grain distribution is by the standard screen scale developed by W. S. Tyler and the method of plotting the cumulative screen analysis. The area of surface of each successive opening in this screen scale is just double that of the next finer or half that of the next coarser sieve. The series of sieves fulfilling this geometrical ratio are 10, 14, 20, 28, 35, 48, 65, 100, 150, 200, 270 mesh. When results from such a screen analysis are plotted on graph paper on which the cumulative percentage over each sieve (vertical) is plotted against the width of opening in the sieves (horizontal) a picture of the grain distribution of the sand will be obtained. The spacing is not equal on the horizontal coordinate because the cross sectional *area* of each grain is twice the area of the one succeeding it or its *diameter* is the square root of 2, or 1.414 times as great as the succeeding grain. Therefore, each spacing is 1.4 times as wide as the one to the right of it.

What, then, is the use of such data in basic sand research? How can it be applied to the foundry? To answer the first question conceive an ideal molding sand whose grains have the ability to stick together without the need of bond. This sand as shown in Fig. 1 would present a nearly smooth surface to the casting and vent would be provided between the interstices of each grain. The graph of such a sand as depicted in Ideals a, b and c in Fig. 2 would be a perfectly straight line from the mesh through which all the sand just passed to the finest grain size. The amount of vent would be determined by the size of the smallest grains, the larger



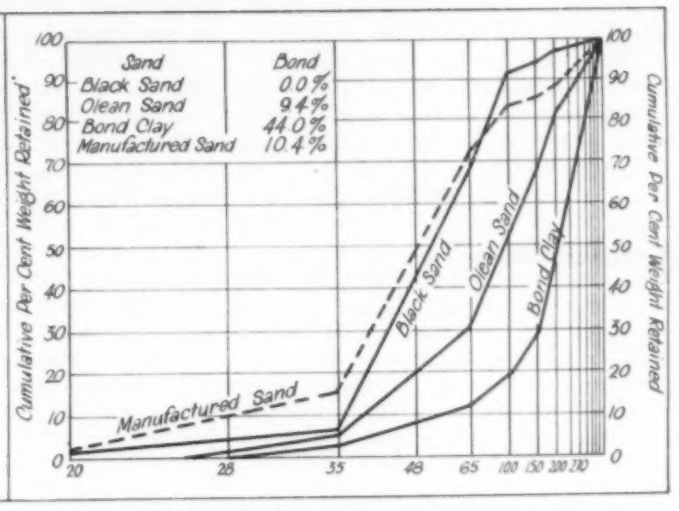


FIG. 2—GRAIN DISTRIBUTION IN IDEAL SANDS, IMPROPERLY BLENDED AND IMPROVED SANDS. FIG. 3—CURVES SHOWING CHARACTERISTICS OF SYNTHETIC SAND AND ITS SEVERAL COMPONENTS

the smallest grain size, the more open the sand would be.

In practice a coloidal bond such as clay has to be used. Therefore, a concession has to be made to the ideal to make room for bond in the grain structure and it is found that the curve sags. The point that is important is that the grain is still the base of the sand and its proper distribution is still mainly responsible for smoothness of the casting, permeability and tempering qualities. The buffer which prevents iron from penetrating the sand and burning in is an assortment of grains, uniformly coated with bond, which can present a compact surface to the iron. The thing that chiefly determines vent is the amount of fines, usually grains of less than 150 mesh in the finer sands, which will give the proper balance between vent an compactness. The tempering and flowing qualities of the sand are largely determined by the general gradient of grain distribution so that proper moisture is retained by surface tension and not by filling the pores with water.

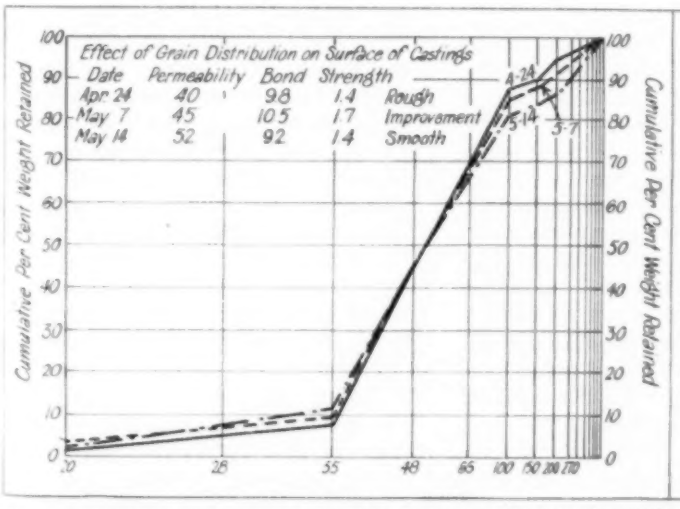
The second question put forward is: How can base grain distribution be applied to the foundry? The answer is first to make an analysis of the heap sand producing good castings and draw the curve. By comparing this curve with curves from heaps producing inferior castings the desired curve for the work is obtained. Limits beyond which one dares not go are discovered.

Chose New Sands

The next step is to analyze the new sands available and plot their curves. A sand with the same shape curve or a combination of sand which will give a sand with the properties desired is chosen. The new sand shall be a little coarser to take care of the break up of the grains in use and sufficiently higher in bond to replace burnt out bond. Therefore, the curve of the new sand should be a little to the left of the curve showing the final condition of the heap. To illustrate this method several specific cases will be described.

The first example is from heaps producing light, high finish, gray iron castings. Results were erratic as to stength and tempering qualities from day to day and when the curve was plotted the grain distribution was far from ideal, as may be observed in Fig. 2. There is a slow rise from 20 mesh up to 200 mesh then a sudden rise from there on due to the fact that 60 per cent of the grain residue went through a 200 mesh screen. Obviously, there were too many fines in this sand. It was discovered that the heaps were made by combining an open No. 2 sand with a fine No. 00 sand that had been used in aluminum work. The coarse sand was to give permeability while the fine sand was to give bond and smooth surface, but the result was a heap deficient in grains from 100 to 150 mesh which was weak and did not temper well.

Witness the result of using a sand with a more uniform gradient in


Effect of Grain Distribution on Surface of Castings
Date Permeability Bond Strength
Apr. 24 40 9.8 1.4 Rough
May 7 45 10.5 1.7 Improvement
May 14 52 9.2 1.4 Smooth
4-24
5-14
5-7
Cumulative Per Cent Weight Retained
Cumulative Per Cent Weight Retained

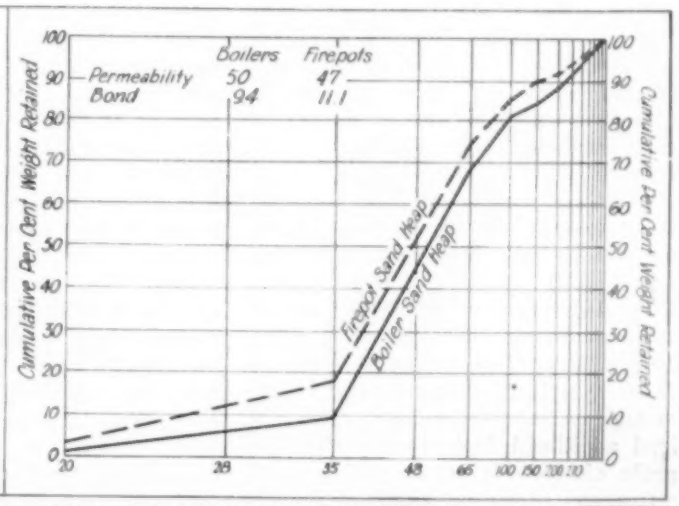


FIG. 4—SHOWING THE SLIGHT VARIATIONS IN GRAIN SIZE WHICH AFFECT SMOOTHNESS OF IRON SURFACE. FIG. 5—SHIFTING THE CURVE BODILY TO THE LEFT FORMED A SUITABLE SAND FOR MAKING FIREPOTS

screen test. This sand appears finer because it only has 9 per cent over 65 mesh against 24 per cent over 65 mesh in the original sample. The permeability is greater in the new sand, however, 23 against 15 in the old, and this in spite of the fact that the new sand contains more bond than the old. This illustrates the statement made when discussing the ideal sand, that openness is governed more by grains around 150 mesh than the coarsest particles in the sand. This is true of the finer sands. A more general statement which will hold for all sands of all grades is that the one having the smoothest curve will have the best balanced ability when considered from the angle of base grain distribution.

The castings made in this foundry were boiler sections which varied in size from 130 to 630 pounds. It was necessary that all these castings be made from one sand and it was found that a heap with 45 to 55 permeability did all this work well. Fig. 3 shows the three raw materials used in making the sand and the resulting product. The black sand was the burnt core sand and it may be seen from the sudden rise in the curve that it is of uniform grain, as would be expected from a lake sand, having 85 per cent of its grains between 35 and 100 mesh and only 5 per cent

What really happened is shown in Fig. 4. The upper curve was taken from a heap sand which produced rough castings. This sand was made from black sand and clay only. It had a narrow tempering range but outside of this it showed good physical properties in the laboratory routine tests. Bond was between 9 and 10 per cent; permeability was between 45 and 50, and strength was satisfactory. The sand dried out rapidly and went dead easily in spite of the amount of bond added. Conditions began to improve as soon as the molding sand was introduced in the synthetic mixture until perfect results were shown by the sand indicated by

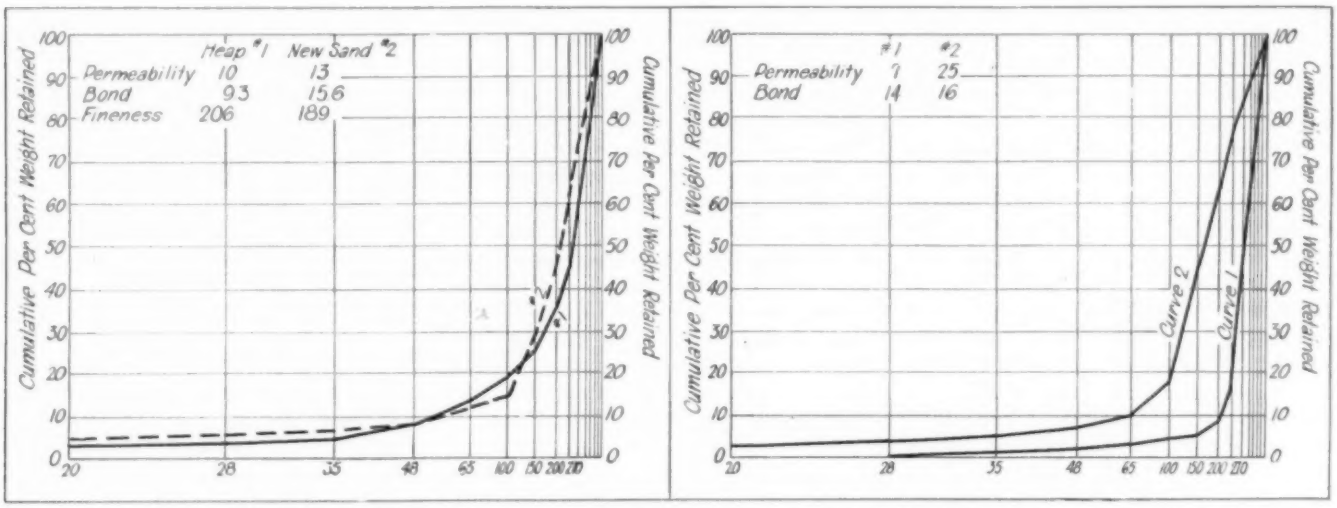


FIG. 6—A COARSER SAND WITH A HIGHER BOND GIVES BETTER RESULTS IN BRASS MOLDING. FIG. 7—FINE SAND (CURVE 1) CAUSED DIRT WASH, ETC. CURVE 2 SHOWS THE IMPROVED SAND

physical properties. Another point that can be brought out from this example is that a fine sand does not always carry enough colloidal bond in it to rebond sand heaps. This sand when tempered up felt like it was much higher in bond than it really was, but tests and foundry results showed that it was still weak. This was due to the illusion created by the 60 per cent fines which gave the feel of compactness to the hand but fine grains are not bond in any sense of the word and when present in excessive amounts only close up the sand without any contribution to strength.

The next sample is of a manufactured sand development in which burnt core sand was used as a base mixed with clay for bond. It was a development with which the author was connected while in the foundry of a large boiler and radiator manufacturer and illustrates several points in molding sand technology. This will lend additional facts to the effect of grain distribution on tempering properties and show something of the relationship of bond content and permebetween the 100 and 200 mesh screen. The bonding clay was a surface clay with 45 per cent colloidal bond and was incorporated in the synthetic sand mixture by mullers manufactured by the National Engineering Co., Chicago. The residue after the bond had been washed from this clay is shown and it may be observed that it was a fine sand having 58 per cent of its grains pass the 200 mesh screen.

The third ingredient found necessary in this mixture was the molding sand shown. This sand had 50 per cent of its grains between the 65 and 200 mesh screen. When these three materials were combined in proper proportions results were obtained as shown in Fig. 3. This is a composite of the three individual curves also shown. The molding sand ingredient was found necessary in this mixture to insure smooth surface on the castings. The foundryman quickly found that this was necessary and his reasons were that it strengthened the heap sand. Extra bond would not take the place of the sand but would only make the sand heavy and sticky, so, it was not bond the sand needed.

the third curve. What really happened was that the first sand was deficient in grains in the 65 and 200 mesh range and this constituent was supplied by the molding sand. In other words, a well bonded molding sand will present a gradient of grain sizes which will resist the penetration of molten iron better than any combination of just sand and bond, no matter how refractory they may be. The author believes that if there were some method of testing the surface tension of the water-bond film on the well graded sand, such test would show a marked relationship to the tempering qualities of the sand.

What is the relationship of bond to this sand? This sand was found to be able to carry 8 to 10.5 per cent colloidal bond to the best advantage. If more bond was required the coarseness of the sand had to be increased in proportion so as not to close up the grain. If greater permeability was required, the amount of fine grains could be reduced only so far before tempering trouble was encountered. Further opening had to

(*Concluded on Page* 109)

Fundamentals of
FOUNDRY PRACTICE

A Variety of Mixing Machines Have Been Developed To Prepare the Sand for the Foundry Molding Floor

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part II

ROTARY dryers, one type shown in Fig. 11, consist of sheet metal drums, mounted on four rollers, and having revolving paddles mounted on the inside of the drum. A pinion, a set of gears and a worm-drive, impart a rotary motion to the drum. The drum is almost entirely bricked in and is heated by the furnace *A*. A hopper *B* introduces fresh sand to one end of the drum. Paddles carry it along to the other end of the drum, where it comes out perfectly dry and ready to be crushed. Fig. 14 shows a plate dryer. The sand is introduced from above and drops on to the first plate, which rotates slowly. After one complete turn, the sand is scooped off by a paddle which throws it down on to the second plate then on to the third and finally out. A furnace at the bottom sends a current of hot air through the chamber and causes the sand to dry rapidly.

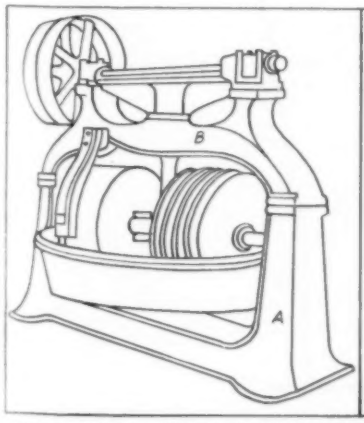
Fat or strong sand is spread over a cast-iron slab or plate, then crushed with a short roller weighing about 660 pounds. The crushed sand is screened through a 1-millimeter (25-mesh) screen. The particles that do not pass through the screen are again rolled, crushed and screened. The refuse left after this second screening is crushed with a rammer in a receptacle of some kind (an old boiler, ladle, or anything) then rescreened.

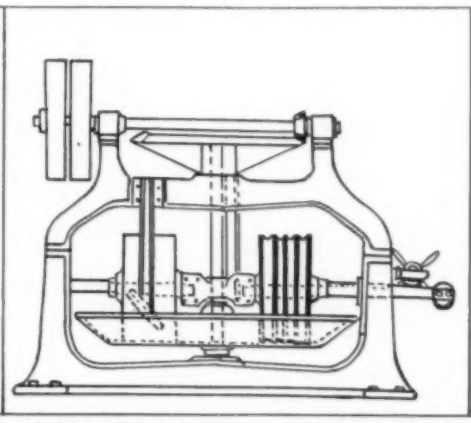
Old dry sand is screened through 1/12 to ⅛-inch mesh screens. The refuse is crushed in the screen itself by rubbing a wooden pounder against the screen, as the refuse usually is nothing but lumps of fat sand. Nails and pieces of scrap are thrown into a basket and taken to the cupola.

After the sand is crushed it must be mixed. The strong sand and the floor sand are spread on the iron slab which was used for crushing the sand, and the sand is then mixed with the shovel. If a green sand mixture is desired, a certain amount of powdered coal should be added. The material now is wetted down, and mixed a second time, then it is spread evenly to a thickness of 4 inches and treaded over carefully to crush any lumps. After this the sand is shoveled into a heap, and if it is not to be used immediately, is allowed to remain thus for a whole day, to allow the moisture to penetrate well. Finally the sand is screened through a ½-inch mesh screen. Pieces of iron about ¾ inch in diameter and 10 inches long are placed in the screen with the sand to break the lumps. The sand thus obtained is of fine

Mechanical Mixers

EUROPEAN foundrymen have developed and tried out a great many pieces of mechanical equipment for preparing sand and in that respect present a decided contrast to American foundrymen who have settled upon three or four machines to do all the work in their foundries. The author holds no brief for any particular type of machine, but presents an impartial description of each piece of equipment with its advantages and disadvantages. Even if the reader can find no application for many of the pieces of equipment, he will be interested in the amazing number of ideas on the subject of sand mixing which have been translated into pieces of moving mechanism. In effect this chapter is a symposium on the subject of sand mixing mechanically and represents practically everything that has been tried up to the present.





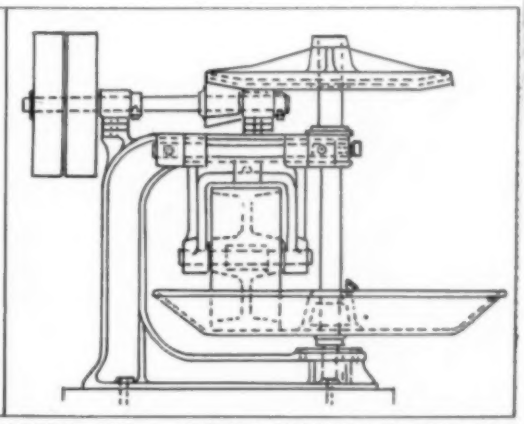
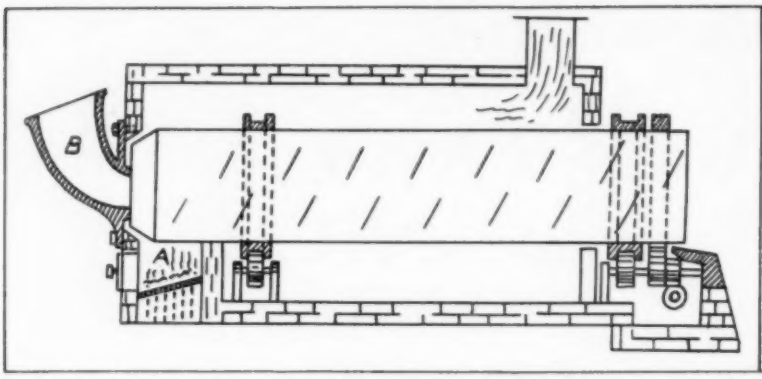


FIG. 8—LEFT—THIS PAN REVOLVES UNDER THE ACTION OF THE GROOVED ROLLERS. FIG. 9—CENTER—ROLLERS IN THIS PAN ARE DRIVEN THROUGH A UNIVERSAL JOINT. FIG. 10—RIGHT—IN THIS SMALL SAND MILL THE BOWL REVOLVES UNDER A SINGLE ROLLER



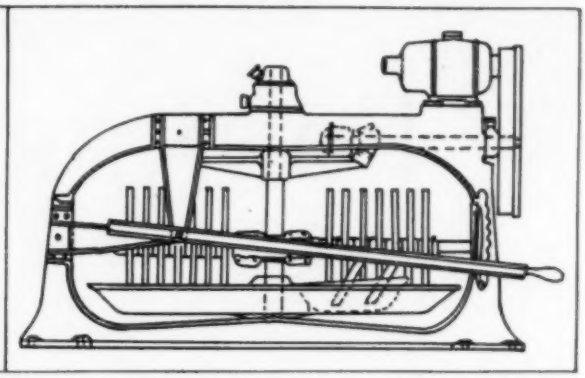


FIG. 11—LEFT—SAND FOR CERTAIN PURPOSES IS DRIED IN A REVOLVING DRUM PROVIDED WITH BAFFLE PLATES. FIG. 12—RIGHT—THIS PAN IS DIRECT DRIVEN BY AN ELECTRIC MOTOR

quality, but the method of preparation is hard on the men, and furthermore is slow and expensive.

Sand dried in the stove or in the mechanical dryer, is stored in a bin with a side-opening outlet, located directly above the crusher. Hoppers with bottom opening outlets as shown in Fig. 15 are inconvenient in some respects. They are hard to operate on account of the weight of the sand which presses against the slide. Also it is hard to regulate the amount of sand which sometimes fills the crusher with too large a quantity.

Hoppers with bases and side opening sliding doors, Fig. 15, are better. The sand does not exert any great pressure against the slide. All that is necessary is to poke it from time to time to make the sand drop down. In addition, the slightly inclined bottom of the hopper makes the sand slide more readily.

The ordinary mortar crushers used by contractors, cannot be used in foundries. Their heavy rollers crush the sand and thus reduce its permeability.

A foundry crusher simply should crush the lumps of sand and thoroughly mix the old and the new sand, whereas the contractors' crushers will pulverize cinders, bricks or anything of like character that is thrown into them indiscriminately.

Fig. 8 shows a grinding mill with rotating bowl, in which the frame *A* is cast in one piece with the cross-member *B* which also has attached to it the gear-drive. The shaft of the bowl turns in a bearing with a thrust-collar of hardened steel or ball bearings, and is guided at the top by a bearing placed in the center of the upper cross-beam.

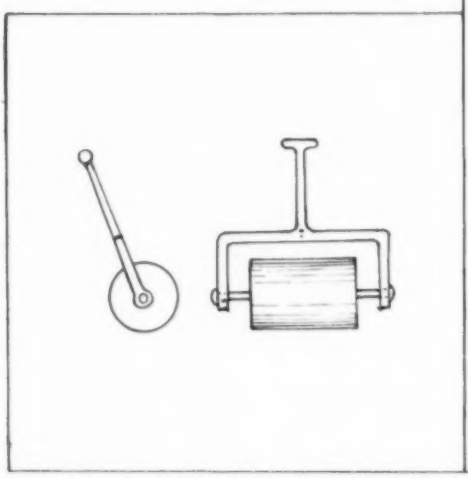
Describes Grinding Mill

The pinion is on the opposite end from the pulleys to equalize the strain on both rollers as much as possible. The steel paddles attached to the supports and adjustable in a guide, throw the sand into the path of the rollers in one fixed plane. Contrary to the usual supposition, independent rollers do not give as good results. Owing to the fact that the shafts are short, the rollers wear obliquely. With a one piece shaft the movements are less pronounced and the whole assembly has more stability. The ends of the roller shaft run in grooves on the inside of the frame. This outfit is robust and if kept well lubricated will suffer little wear. It can be used with wet sand, dry sand or for grinding loam.

After the bowl has been used for several years, a cast iron one-piece ring or one in several pieces, is placed in the bottom of the bowl. This can be bolted or simply bedded in cement. Some mills are provided with a bowl and rollers made of chilled iron which increases their life considerably.

Let us now look into the use of mills in connection with the various ways of preparing sand. In the mill shown in Fig. 8, the material is taken out with a shovel. The mills are built with bowls varying in diameter from 4 to 8 feet.

Fig. 9 shows a mill of the same type as that shown in Fig. 8. The bowl is flatter and is not quite as deep. A kind of linked deflector is lowered to make the sand pass to the outside. This mill avoids some of the disadvantages shown in others, and simplifies operation. Where the mill is combined with a temperer, the sand is transferred automatically from one



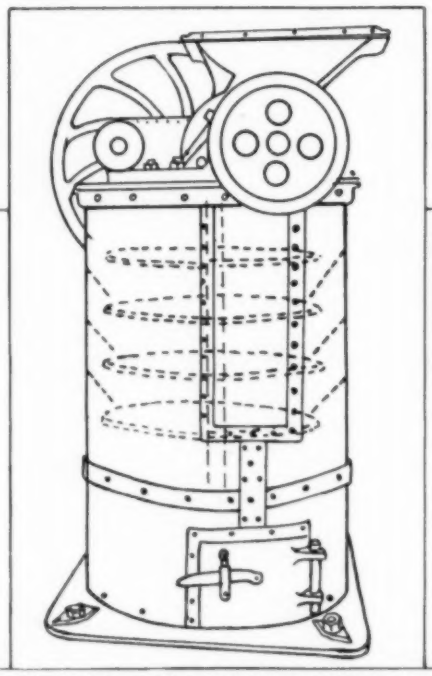


FIG. 13—LEFT—THE DRIED SAND IS SPREAD ON A PLATE AND CRUSHED UNDER A ROLLER. FIG. 14—CENTER—SAND ENTERING THE TOP FALLS FROM PLATE TO PLATE IN A REVOLVING HEATER AND IS TAKEN OUT DRIED AT THE BOTTOM. FIG. 15—RIGHT—TWO TYPES OF SAND HOPPERS

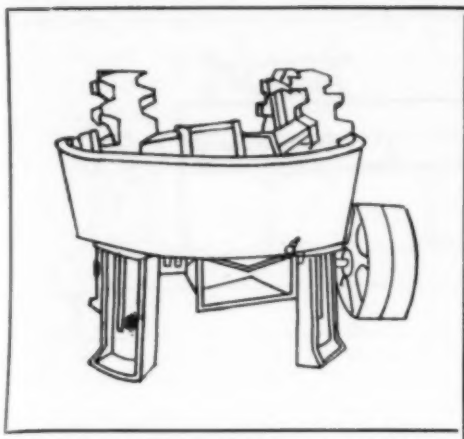


FIG. 16—IN THIS TYPE MIXER THE BOWL REMAINS STATIONARY

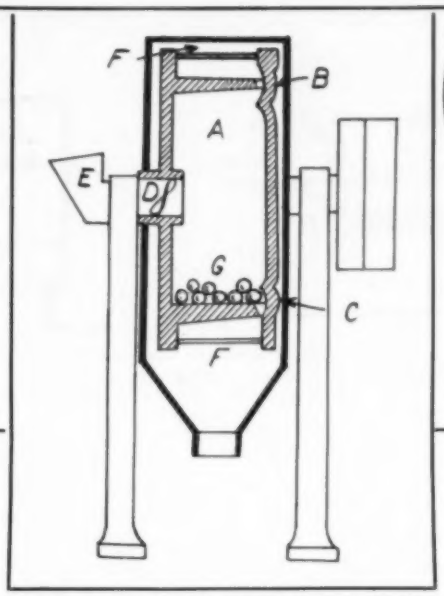


FIG. 17—SAND IN THE DRUM IS CRUSHED BY A NUMBER OF IRON BALLS

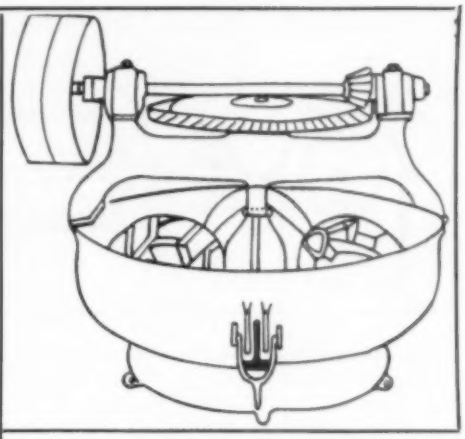


FIG. 18—PERFORATED METAL SPHERES REVOLVE ON THE TRAVELING ARM

machine to the other and production is increased greatly.

Small foundries employing but few men, use a small mill with a rotary pan and one roller, as shown in Fig. 10. This machine handles sand perfectly either in a dry or wet state, mixes it and gives it more plasticity for molding. The diameter of the bowl is approximately 3¼ feet and it is emptied with a shovel.

Driven by Electric Motor

Where the mill is located at some distance from a line-shaft, it may be driven by an electric motor as in Fig. 12. If the machine is mounted on ball-bearings, the power required to drive it is decreased considerably. A mill with bowl diameter of 7 feet 8 inches, will not require more than 5 horsepower at maximum load to drive it. The foundryman should look into the question, whether the increased expense involved in such an improvement is justified by the increased output.

The various mills described and shown in Figs. 8, 9, 10 and 12 are driven from above and have an overhead drive. Many foundrymen prefer this to the drive from below, for the following reasons: The belt is not an objection, there is no danger of accidents, the sand cannot drop on the pulleys during operation and cause the belt to slip, the line-shaft usually is located above and decreases considerably the length of the belt. In mills driven from below, the bevel gears are attached to the bowl, the bevel pinion is on the same shaft as the pulleys.

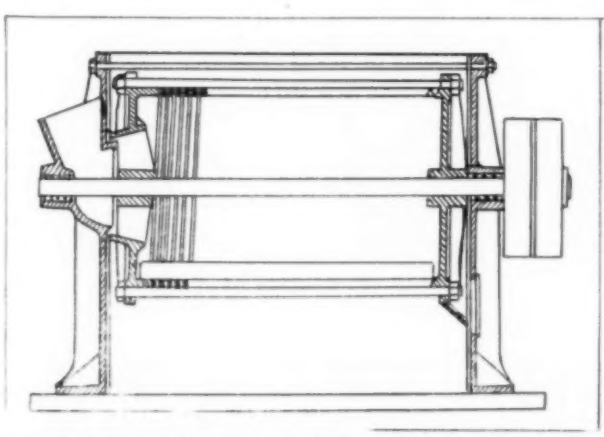
In the mill shown in Fig. 16, the bowl is stationary and is supported on four uprights. The whole forms a frame in the center of which is a vertical shaft having a set of bevel gears mounted on the lower end. The upper end carries a guide-block for the shaft on which are mounted the toothed rollers. The bowl is provided with a door through which the prepared sand is discharged. The mill handles the sand satisfactorily but the shafts wear rapidly. Loam mortar cannot be prepared in this mill, as the centrifugal force of the rollers throws it out. The same objections hold with dry sand, which collects in the indentations in the rollers and is thrown out of the pan. The sand lands on the driving pulley and causes the belt to slip, and wear out quickly. Mills also are built with conical rollers but their efficiency is low, as the rubbing action in the bottom of the bowl is reduced greatly. The cylindrical mill causes an energetic rubbing of the sand and gives a high production.

Sometimes mills are used in which several rings are mounted with spaces between on the shaft as shown in Fig. 12. Their efficiency is fair but they cannot reach the output of the cylindrical rollers mounted in one piece. They are used in mills of large diameter where the friction on the pan would make the operation of the machine difficult.

Can Handle Wet or Dry Sand

All the foregoing mills can handle wet or dry sand equally well. The drum mills are only adaptable to dry sand. They have the advantage of requiring but little power to operate them, but as the milled sand falls immediately out of the drum, the mixing is not complete.

Fig. 17 shows a ball mill, consisting of the drum *A* with openings at *B* and *C*. The sand is introduced through the hopper *E* and the hollow spindle *D*. A paddle on the inside of the hollow spindle facilitates the introduction of the sand into the drum.



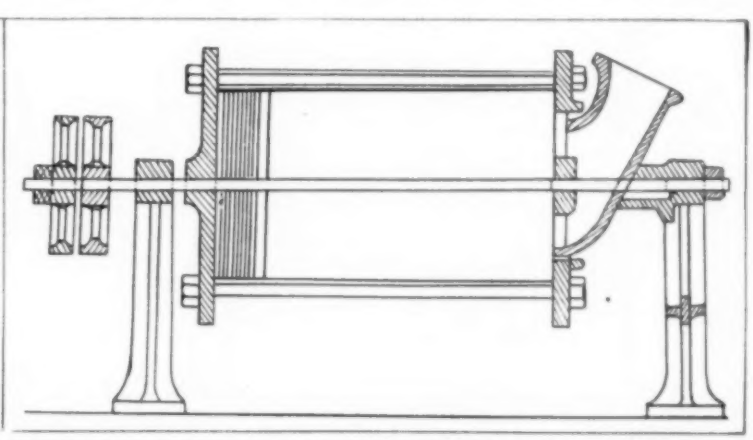


FIG. 19—LEFT—SAND IS DISCHARGED FROM THIS DRUM THROUGH THE ACTION OF A HELICOID GROOVE. FIG. 20—RIGHT—SAND IN THIS DRUM IS CRUSHED BY A LONG IRON ROLLER AND FALLS OUT THROUGH THE SLOTS BETWEEN THE VERTICAL RINGS

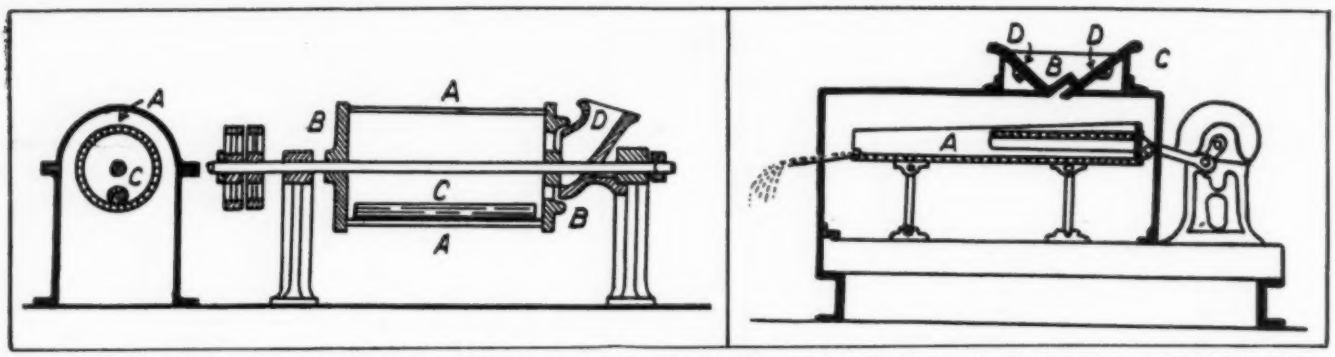


FIG. 21—LEFT—THE SAND IS CRUSHED BETWEEN SEVERAL SMALL ROLLERS AND FALLS OUT THROUGH THE HORIZONTAL SLATS. FIG. 22—RIGHT—THE OSCILLATING SCREEN IS OPERATED BY A ROD AND CRANK

The outside is covered with a metallic screen *F*, which acts as the riddle. The whole machine is enclosed in a sheet metal casing. The balls *G* in the drum come in direct contact with the dry sand.

The crushed particles land on the screen, which allows some of the sand to come through. Owing to the rotation of the whole machine, the refuse falls back into the drum and is again subjected to crushing. This machine operates well, but the quantity of sand to be crushed must be regulated carefully.

Describes Simon Mill

The Simon mill shown in Fig. 21 is a drum mill. It consists of steel staves *A*, separated from each other by about 0.04 inch and reinforced with steel bands, attached to two chilled iron plates *B*. A roller *C*, of chilled cast iron, revolves freely in the bottom of the drum and crushes the sand introduced through the side hopper *D*. This mill requires little power. Operation is excellent, except for the inconvenience resulting from metallic particles lodging between the bars and causing differences in the size of the openings through which the incompletely crushed sand escapes. The mill is enclosed completely in a sheet metal housing.

In the mill shown in Fig. 20 invented by Dechange, the drum is formed by a series of rings having small fins with a thickness of about 0.04 inch. The purpose of these fins is to maintain a suitable distance between the various rings. Two heavy plates, held together by rods, hold all the rings together. A cast iron roller inside the rings crushes all the material introduced as in the Simon mill. The mill is enclosed completely in a sheet metal housing. The sand is discharged promptly through the bottom and therefore is not subjected more than necessary to the action of the rollers.

The machine of the drum type shown in Fig. 19, presents an interesting feature. Sand is screened and discharged through a helicoid groove. This arrangement helps to discharge the residue through an opening at the opposite end of the hopper. In the machines shown in Figs. 17 and 21, the residue remains inside the drum where it is continually subjected to the action of the roller. To remove the residue, the machine has to be stopped, and the roller removed through an opening in one of the endplates. The helicoid groove of the machine, Fig. 19, also aids in the mixing of the sand. This machine also is enclosed in a sheet metal housing.

The list of mills with stationary bowls includes the rubbing mill designed by Hauchin of Paris and shown in Fig. 18. Practically its only field is for the treatment of sand in a wet condition. A vertical shaft turns in the base of the lower half of the stationary bowl and the upper end of the shaft rotates in the cross-beam which supports the paddles and the driving pulleys. Four plain or perforated metal balls are attached loosely to the ends of arms supported on the vertical shaft. This machine supplies a well-worked sand, but when the spheres are worn to some extent they no longer turn, but are dragged around the bottom of the bowl. However the upkeep is not great, changing the driving pinion and the rings is all that is necessary. All pieces subject to wear are cast in hard iron. The sand is discharged through an opening in the bottom of the bowl.

Screening the Sands

When a mill is used simply for crushing the sand, it is absolutely compulsory to submit the sand to another operation, screening. Some mills are provided with a screen and have a special arrangement which constantly returns the refuse from the screen into the mill. However usually it is preferable to separate the two operations, crushing and screening to remove the foreign matter such as nails and dirt

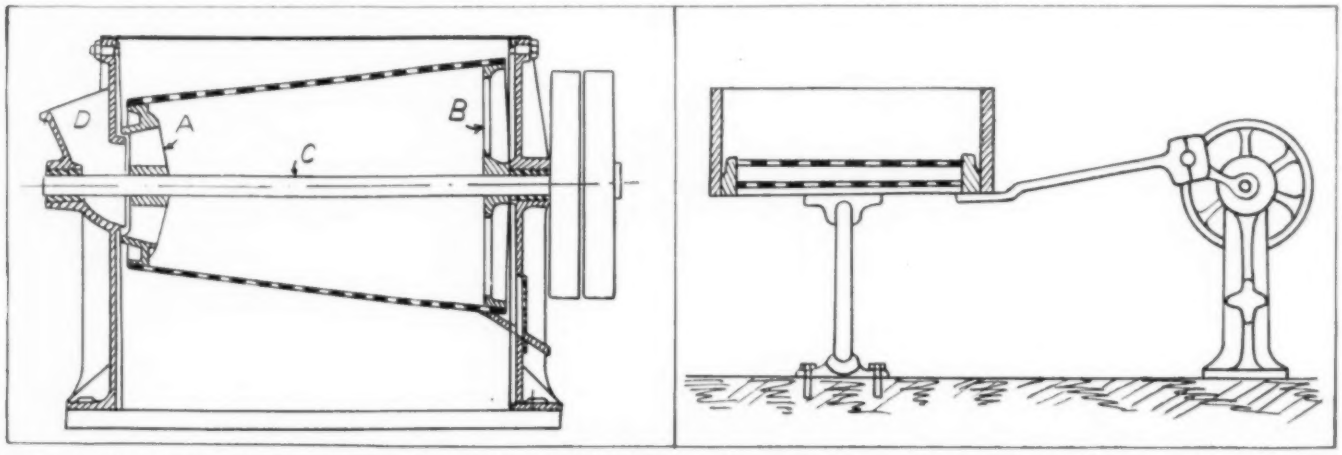


FIG. 23—LEFT—THE TAPERED REVOLVING SCREEN FACILITATES THE REMOVAL OF THE RESIDUE. FIG. 24—RIGHT—JOLTING SCREEN OPERATED BY COMPRESSED AIR IS HIGHLY EFFICIENT

that it may contain as fast as it accumulates. Portable screens as shown in Figs. 2, 3, and 4 obviously could be used for screening the sand. As a rule the screens are stationary and mounted on foundations close to the crushers.

The oscillating screen shown in Fig. 22 is mounted on four steel bands, 1¼ inches wide and ⅛ inch thick which act as springs. The screen consists of a sheet metal box *A* open on one side. The bottom is a metal screen with a mesh of about 0.04 inch. At a distance of about 12½ inches above this screen, there is another screen *B* with a ⅛-inch mesh which protects the fine screen under it from the impact of the sand coming down through the hopper *C*. This hopper closes automatically by counterweights attached to the two shutters *D* and *D*.

The screen is operated by a rod and crank. The entire machine is mounted on a steel frame, and completely enclosed by a sheet-metal housing.

In some oscillating screens, on account of the springs breaking quite easily, they are replaced by linked pivoted rods, Fig. 25 or by small shafts ¾ inch in diameter which carry four rollers 2 inches in diameter, on which the frame rolls without effort.

For screening dry sand it is preferable to use rotary drums. In the drum shown in Fig. 23 two cross-arm ends either in the form of a circle or a polygon, are mounted on a central shaft *C*. One end is much larger than the other. This difference in size gives a tapering form to the drum which helps in the discharge of the residue. The walls of the drum are formed of metal screens through which the sand passes and the whole is mounted in a sheet-metal housing. The sand is introduced into the drum through a hopper at one end. The screen does not require any great amount of power to operate it.

Some rotary drums are of the overhanging type. They are supported by only one cross-arm mounted on the end of a shaft. Such an arrangement makes it easy to introduce the sand into the drum. Rotary mills sometimes have two rollers which support the drum at the opening end. From the foregoing it will be seen that the ball mills made by Simon, Dechange and Lamoureux, simultaneously crush and screen the sand. The screens for the dry sand only handle sand that has received a prior crushing.

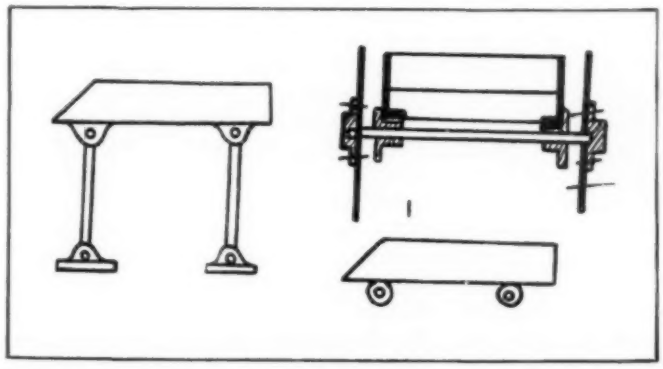


FIG. 25—ALTERNATIVE METHODS OF MOUNTING THE OSCILLATING SCREEN

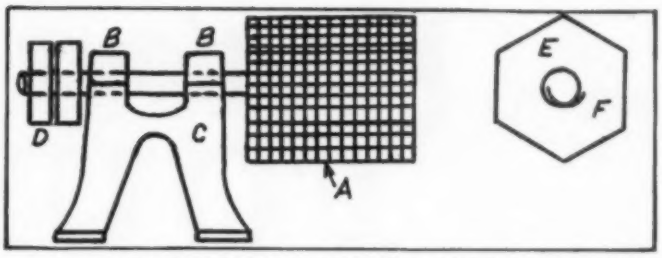


FIG. 26—PLAIN, HEXAGONAL REVOLVING SCREEN FOR SMALL INSTALLATION

A screen similar to that shown in Fig. 24 is advantageous for preparing damp green sand. The connecting-rod is attached solidly to the frame of the screen, and a small fly-wheel regulates its speed. Due to the movement given to the crank, the sand in the frame is jolted quite strongly. The output of this screen is high. The oscillating screens present no real advantage unless they are operated by compressed air, which gives them the desirable jolting.

Fig. 26 represents a rotary wet sand screen, consisting of a six-side drum, covered with a metal screen of ½-inch mesh, attached to the end of a horizontal shaft revolving in the bearings of a suitable frame. On the opposite end of the drum are mounted the two driving pulleys. Sand is introduced into the drum through the opening at one end. One of the panels of the drum can be removed quickly for cleaning by loosening two wing-nuts.

Schedules Meetings for Gray Iron Founders

Gray Iron Institute, Terminal Tower building, Cleveland, has begun a series of meetings throughout the country for gray iron foundrymen. The first meetings of the series will be conducted in the central western territory and will be in the form of a luncheon followed by a discussion of organization affairs such as the various activities of the institute, explanation of the cost system recently made available to the industry, etc. The first of the meetings was held Jan. 7, at the Cincinnati club, Cincinnati; the second Jan. 14 at the Palmer house, Chicago and the third Jan. 15, at the Schroeder hotel, Milwaukee. Other meetings are scheduled for Jan. 17, Nicollet hotel, Minneapolis; Jan. 25, Pere Marquette hotel, Peoria, Ill.; Jan. 28, American Annex, St. Louis; Jan. 31, Kansas City Athletic club, Kansas City, Mo.; and Feb. 4, Roosevelt hotel, Cedar Rapids, Ia. The last two meetings probably will be held in the places indicated although the locations are not definite.

The institute also is organizing local chapters in important foundry centers of the country for the discussion of affairs of the organization. The first of these chapters was organized Dec. 19 at a meeting held at the Statler hotel, Buffalo. Temporary officers were elected and were authorized to proceed with the organization of the chapter and to submit recommendations for the next meeting.

The following companies compose the nucleus of the Buffalo chapter: J. W. Pohlman Foundry Co., 205 Baitz avenue, Buffalo; Niagra Foundry Co., 835 Ashland avenue, Niagra Falls, N. Y.; Buffalo Foundry & Machine Co., 1543 Fillmore avenue, Buffalo; Riverside Foundry Corp., 1144 Military road Buffalo; Lawler Iron Works, 18 Gull street, Buffalo; Lake Erie Foundry Co., 218 Chicago street, Buffalo; Steel Drum Accessories Corp., 38-46 A street, Buffalo and Dobbie Foundry & Machine Co., 150 Portage road, Niagara Falls. N. Y.

Quad-City Foundrymen To Meet

The regular January meeting of the Quad-City Foundrymen's association will be held at the Fort Armstrong hotel, Rock Island, Ill., Jan. 20. Leroy P. Robinson, Werner G. Smith Co., Cleveland, will speak on "What Has Become of the Foundrymen's Dollar."

Wants Permanent Molds

Galt Malleable Iron Co. Ltd., Galt, Ont., Canada, wants the names and addresses of firms which supply permanent molds for the manufacture of aluminum castings.

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Gear Structure Varies

QUESTION

We are making gears and pinions with molded teeth which are not machined for hay presses. Sometimes the teeth are hard and chip easily and other times the teeth are too soft and wear away rapidly. Would you recommend lubricating the teeth of such gears with cup grease where they are subjected to dust and dirt as encountered in baling hay?

ANSWER

It seems to us that there must be considerable variation in your iron mixture if the gears are hard one time and soft the next. It may be that the hardness instead of being due to hard iron, comes from a too free application of the swab in repairing the mold at the tooth projections. This would cause a chilling action at that point. Too hard ramming also might cause the same effect.

The analyses for gears vary according to the size. Large gears like heavy castings have lower silicon, and small gears have higher silicon to prevent chilling or white iron effect. The following analyses are recommended:

Heavy	
Silicon	1.0 to 1.5
Sulphur	0.08 to 0.10
Phosphorous	0.30 to 0.50
Manganese	0.80 to 1.00
Medium	
Silicon	1.50 to 2.00
Sulphur	under 0.09
Phosphorous	0.40 to 0.60
Manganese	0.70 to 0.90
Small	
Silicon	2.00 to 2.50
Sulphur	under 0.08
Phosphorous	0.50 to 0.70
Manganese	0.60 to 0.80

Dust and dirt of any kind cause an abrasive action on rubbing parts and if possible, the parts should be enclosed to protect them from dust. However, unless the gears are enclosed we believe that lubrication by causing the dust and dirt to adhere to the moving parts will cause greater abrasion. With enclosed gears we suggest a heavy oil similar to automobile transmission oil instead of grease.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Iron Pot Resists Acid

QUESTION

Can you supply me with a suitable gray iron mixture for a pot that will be acid resisting? The pot will be 4½ inches thick and 10 feet in diameter. Will ordinary hard iron be suitable?

ANSWER

We suppose that the acid resisting pot that you refer to is the usual type that not only must be resistant to acid, but also to heat. Therefore, we suggest that a low silicon mixture be used. With a metal thickness of 4½ inches, the silicon can be run about 0.50 per cent. The sulphur should be held as low as is possible and the manganese about 1.15 to 1.25. Phosphorus also should be kept as low as possible; not over 0.3 per cent, if you can manage it.

Air furnace iron would be the best for pouring a casting of this size, but we presume that the metal will be melted in a cupola. Use a considerable amount of carwheel scrap with malleable pig iron, and use about 25 per cent steel in the mixture. The steel will assist in keeping the carbon down, and give a fine grained iron which is necessary in acid resisting metal.

Q & A

Lacks Vent Under Drag

QUESTION

We are forwarding for your inspection a 4-inch cast iron gate valve which shows a number of blow holes at the point where the drag flange joins the body below the oval opening. The casting is made in the usual manner from a split pattern on a stripper machine. The steel flask is placed directly on a sand bed without a bottom plate. There is only about one inch of sand in the mold below the flange. My impression is that the gas in these holes is caused by hard ramming over the flange, although the flange itself shows no evidence of this. The gas naturally would be trapped under the core at this point. The core itself is vented at the joint, but there may be a possibility that a hard spot on the bottom is the cause of the trouble. The character of the defect has aroused considerable discussion and the presentation of a number of theories, some apparently far fetched. I will appreciate your opinion.

ANSWER

Your own theory is the best. The defect is caused by steam which cannot escape rapidly enough from the sand corner formed between the flange and the bottom face of the flange. Probably the sand is rammed a little too hard, but it must be rammed pretty firmly at that point to prevent the casting from swelling. The fact that only 1 inch of sand intervenes between the bottom of the flange and the sand bed also is a contributory factor. Without the use of a bottom plate the edges of the steel flask sink into the sand bed and prevent the steam from escaping readily. With a deeper flask and a perforated

bottom plate, or even a plain plate laid on a good sand bed well vented, you would have no trouble. Under existing circumstances the remedy is to use a vent wire. Vent the drag in the vicinity of the flange before stripping the drag from the pattern. Place a ¼-inch rod on the sand bed before you place the drag on the floor. Pull the rod out afterward and that will leave a channel for the steam to escape. By placing a suitable mark on both sides of the drag in line with the inside of the flange you can place the drag accurately over the rod. You will be surprised to note the volume of steam escaping from the openings.

GENERAL

Heat Cracks Are Small

QUESTION

One of our customers has rejected some of our castings for a reason given as *heat crack*. This is the first time we have encountered this term. If there is such a thing as a heat crack, we want to know what it is. How is it distinguished from other variations of breaks? Also we shall appreciate information on the cause and the remedy.

ANSWER

Heat crack is a well known term, particularly in that branch of the foundry industry devoted to the production of enameled ware. Due to several reasons, some mechanical and others metallurgical, the castings develop microscopic cracks when they are reheated in the furnace and thus prevent a perfect reception of the enamel coating. Your problem is one that requires personal investigation by a skilled foundryman familiar with the manufacture of enameled ware.

Q & A

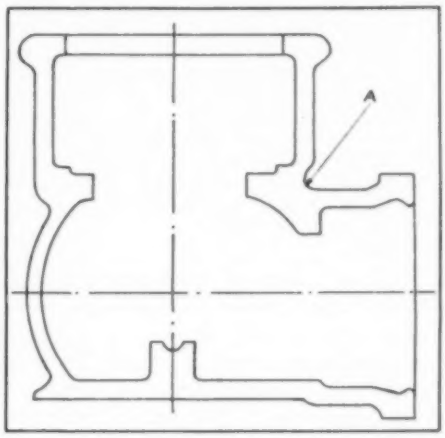
Stop Shrinkage in Angle

QUESTION

We are enclosing sketch of a hydrant foot casting which is causing us considerable trouble on account of a *draw* which always appears in the heavy section marked *A*. We have to weld a crack 2 inches in length, ½-inch wide. How can we prevent a repetition of this annoying defect?

ANSWER

You do not state in what position the casting is poured, but we assume that the sketch shows the casting at the parting line in the pattern and that the casting is made in the usual manner in a green sand mold, with a dry sand core, with one half of the mold in the drag and one half in the cope. The dry sand core rests on two prints and on a single chaplet placed at a point below the intersection of the center lines as shown. A similar chaplet is placed on the cope side to hold the core firmly in place. The runner probably is placed in the open space in front of *A* and a gate is cut into both branches of the casting. Under the foregoing conditions, the position of the gate is a contributory factor to the shrinkage crack. It supplies the hottest iron at a point where it is least needed, that is the heaviest and thickest section of the casting. Theoretically the iron shoud be poured into a casting in a manner to equalize the cooling speed all over, and while this rarely is possible in its entirety, still in many instances the gates can be placed in position to approximate the desired result. In this particular instance the iron could be poured either at the opposite side of the casting, or through a small pop gate on top. The most logical method for curing your trouble is to equalize the casting thickness, either by removing some material from the outside of the pattern at the dangerous area or to add some thickness to the core at a corresponding point on the inside. If this can not be done, for any one of various reasons, then temporary relief may be secured by using a chill in the mold or core at the affected point, or by sticking two or three big head nails in the sand and allow their heads to project into the mold cavity. They will help to chill the iron and prevent it from drawing later.



CASTING CRACKS AT POINT *A*

Q & A

Sand Based on Output

QUESTION

Is there any rule for figuring the amount of sand wasted per ton of iron melted?

ANSWER

From your letter head we note you are engaged in the manufacture of furnaces and boilers. Therefore we assume you are interested in discovering if there is a definite relationship between the amount of new sand required in, say a year, and the tonnage of castings produced in the same period. In other words, in a going concern, producing 10,000 tons of castings per year, how many tons of new sand will be required? In a general way, the answer may be set down as 1000 tons, that is a ratio of 1 ton of sand per 10 tons of castings.

However, while this proportion represents fair, average practice in gray iron foundries engaged in the production of light and medium weight castings, it by no means is universal. In an extensive survey conducted by THE FOUNDRY in the early part of 1926 startling discrepancies were found in the practice of many foundries. Six articles based on this survey were published in THE FOUNDRY from March 1 to May 15 inclusive, dealing exhaustively with the practical phases of the sand situation in the foundry industry. In a table which accompanied the second article the first two columns showed the consumption of molding sand compared with the output of castings in 30 foundries over a period of a year. These foundries were selected as typical out of a list of over 400 which had returned statistical data on a questionnaire sent out.

The list shows no uniformity. The minimum amount reported a consumption of 1 ton of sand for 15 tons of gray iron castings. The maximum (for steel) shows approximately ton for ton.

Q & A

Use Corrugated Paper

QUESTION

One of our foreign foundry friends has written us for further information on the subject of paper cores for pipes. He said he saw a reference to paper cores in a recent paper issued by the bureau of standards. We are not familiar with the subject and will appreciate any information you have to give.

ANSWER

A natural error into which your friend has fallen is in accepting the word paper in the ordinary sense. Also in getting the core barrel confused with the core. As a matter of fact the only part paper plays in pipe making is that in the form of narrow strips, a heavy corrugated cardboard coating is wrapped around the core barrel for small sizes in place of the usual coating of hay rope.

Probably you are familiar with the fact that a coating of some combustible material must be placed on the cast iron or steel core arbor before a coating of loam is applied to form the core. This combustible material

burns away after the core has been enveloped in molten metal, thus providing the necessary clearance for the casting to contract. Also this clearance facilitates the removal of the arbor vertically, shortly after the pipe has been poured and while it still is in the pit.

Q & A

Small Castings Shrink

QUESTION

We are enclosing a blueprint of a small casting which has caused considerable trouble due to shrinkage in the corners. We have placed chills at the affected points, but they do not afford relief. At present we pour these castings from a mixture of 200 pounds charcoal iron and 800 pounds coke iron, but we also have tried various other mixtures with no better results. We will appreciate your opinion on how to overcome the trouble.

ANSWER

From a superficial examination of the blueprint and without any information on the style of gate or riser, or the analysis of the iron employed we are inclined to the opinion that your trouble is due to a shallow cope. You probably are molding the casting in a snap flask and then cutting the iron short in the runner to prevent the casting from straining. Place a runner cup 3 or 4 inches high on top of your cope and pour hot iron through it slowly and unless some other factor is present, the casting will be solid.

The immediate cause of your trouble is the difference in the thickness of metal at the three points indicated and that forming the remainder of the casting. With a low head the gate acts as a sucker instead of a feeder because iron will adjust itself to a level unless forcibly prevented.

There is a possibility, remote of course, but still a possibility that what you refer to as a shrinkage cavity may be caused by gas from an ill vented core or a damp core. Place a large riser over the center of a mold through which you can watch the metal as it rises. If it flutters to any extent it is evidence that the core is not satisfactory and you may expect to find cavities in the casting. In some cases where a shrinkage or draw is not serious and where it is due to adjoining bodies of metal of unequal thickness, the flaw may be prevented by the insertion of a few nails in the face of the mold in such a manner that the heads will project into the mold cavity. The nails serve as interior chills and equalize the cooling speed of the heavy and light sections. However, this is only a temporary measure and should not be adopted if it is possible to design a casting with properly proportioned sections.

Q & A

Radiator Sections Leak

QUESTION

Leaky steam radiator castings used with gas burners are causing us considerable trouble. We use the best of materials and we think our general foundry practice compares favorably with that of other plants engaged in the same line of business. Some of the leaks we can plug, but we can do nothing with others, particularly slight oozy places around the core in the combustion chamber. Sometimes we stop these leaks by allowing the casting to rust. Do you know of any cement we could use to reclaim slightly defective castings? Any suggestion you can give us for producing good water tight castings will be appreciated.

ANSWER

Several methods are available for curing slight leaks in castings. One which you already practice is to allow the casting to rust. A second method is almost the same with the exception that the rusting process is hastened by soaking the casting in a solution of salammoniac. In a third method a thin solution of water glass is forced into the casting under pressure and held there for a short time.

However, the foregoing are only remedial measures to be applied sparingly and under conditions where they will not affect the value or the reputation of the product. Logically, the proper course to adopt is preventive rather than remedial. The porous areas in the castings probably are due to imperfect cores which caused the metal to flutter slightly. Other causes responsible for leaky castings sometimes are dirt, either sand or slag, wet or hard sand or dull metal, but since you state your routine foundry practice is satisfactory, we suggest you commence your investigation at the core bench. For this class of castings a core must be developed that will not cause the least semblance of a flutter when it is completely surrounded by molten metal.

STEEL

Gives Compositions

QUESTION

Can you give me the analysis of stainless steel and any data pertaining to the casting of the same?

ANSWER

Stainless steels for the most part contain from 9 to 60 per cent chromium and from 0.10 to 1.0 per cent carbon. In addition they may contain nickel, silicon, copper, molybdenum and tungsten. The following alloys which come under this classification are cast in foundries for a variety of purposes including acid and heat resisting castings: Chromium, 18 per cent; carbon, under 0.35 per cent. Chromium, 18 per cent; nickel, 8 per cent; carbon, under 0.20 per cent. Chromium, 10 per cent; nickel, 22 per cent; carbon, under 0.25 per cent. Chromium, 28 per cent; carbon, under 0.50 per cent. Nickel, 36 per cent; chromium, 18 per cent; carbon, under 0.50 per cent. Nickel, 65 per cent; chromium, 15 per cent; carbon, under 0.50 per cent. Chromium, 28 per cent; nickel, 10 per cent; carbon, under 0.50 per cent. Practically all of the stainless alloys are patented. Molding practice for the stainless metals is similar to that used in steel foundry practice. The alloys low in carbon are sluggish and require larger gates than higher carbon steels. High chromium irons and steels scum over readily which makes it hard to judge the temperature. The metal must be handled rapidly to insure running of the castings. Molds must be vented carefully and arranged so that they may be filled with the minimum delay. Several articles on the subject of stainless iron and steels have appeared in THE FOUNDRY and are as follows: "Produces Alloy Castings to Withstand Severe Service," March 1, 1929, page 180; "Risers on Alloy Steels," Oct. 1, 1929, page 834; "Heat Treatment of Alloys," Oct. 15, 1929, page 877; and "Molding Alloy Steels," Nov. 15, 1929, page 967.

MALLEABLE

Heat Is More Uniform

QUESTION

Why is it that heat in commercial malleable annealing furnaces is supplied at the top instead of the bottom of the furnace?

ANSWER

Since heating of the furnace contents is accomplished mainly by vertical gas currents in the spaces between the rows of pots, and to a minor extent by conduction downward through the stack of pots and their contents, there is a good scientific reason for supplying heat at the top of the furnace. If one of the vertical passages between the pots is cooler than another, a gas current will be set up—rising in the hotter of the two and descending in the cooler. Consequently when heat is supplied at the top, it will tend to divert the ascending hot gas from the hotter passages toward the colder spaces and thus heat them more rapidly. If the heat was supplied from the bottom, the rising hot gases would draw the incoming heat with them.

Problems in Nonferrous Founding

By Charles Vickers

Has Core Trouble

We make many bushings, using cores from 1 to 4 inches in diameter and 13 inches long. Frequently we have trouble with gas from the cores, causing the bushings to be porous. We have no standardized mixture for making these cores and would appreciate your recommendations as to the proper mixture of sand, compound oil and other binder, which would be suitable for making cores which we could stock for a week or two before using. The cores we make are hand made, and at present we are using a mixture of burnt sand, sharp sand and red sand, with a core compound. However, we find that after becoming a day or two old, the cores become rotten and sometimes crack after being put into the mold, allowing the gas to escape into the casting.

We believe that considerable economy and a great convenience would be obtained by the use of machine-made cores. For straight bushing cores a machine of the sausage-grinder type would be all that is needed, and the manufacturers of the machine will supply tried core formulas. The cost of such machines is trifling in comparison of the savings they effect, and the years of service obtained. This is a matter to be seriously studied. However, as long as the cores are made by hand we think it advisable to use a core oil having a linseed oil base, and all sharp or silica sand, particularly for the cores of smaller diameter. Cores 4 inches in diameter can be made with flour.

A core 13 inches in length, will be made in halves, when made by hand. It is usually customary to make and dry one half of the core of the larger sizes, and use this half as a plate for the other half. In other words one half is dried and is then pasted on top of the green half, thus making a complete core which is turned out of the core box. The dry half gets baked twice. The important matter is the vents in such cores. A channel is cut with the gate cutter in the green half before it is removed from the core box, and for the larger diameters a needle vent wire is stabbed from this channel to the circumference of the core so that every square inch of the surface covered by the metal will carry at least one vent channel.

For a core mixture for large cores, sharp sand mixed with flour in the proportion of 1 flour to 20 sand gives good service. Coat the cores with plumbago wash, or rub on whiting after the cores are dry. No molding sand ever should be mixed with the sharp sand. For the linseed oil cores for bushings use sharp sand only and bond with linseed oil, or core oil with linseed oil base, using 1 part linseed oil to 40 parts of sand. The sand should be dry when the oil is mixed, then be rubbed up with water to the required dampness. For small cores a good mixture is: Dry silica sand, 6 pounds; No. 2 Albany molding sand, 2 pounds and linseed oil, 3 ounces. This makes a satisfactory core.

Q & A

Seacoal Causes Trouble

We are having much trouble at the present time with castings coming rough from our brass department and we would like to know if the use of seacoal in our brass sand would cause this. We are using a mixture of sea coal and old foundry sand with some new molding sand and are having great difficulty securing smooth castings. Would it be of any help to use flour in the sand?

We imagine that being manufacturers of automobile specialties the general run of brass castings made are small, therefore, neither sea coal nor flour are required in the sand. The addition of sea coal would likely cause roughness. It sometimes is found advisable to use sea coal for molds for heavy bronze castings in foundries handling such work regularly. Flour is used for the same purpose, and when used in molding sand in the proportion of 20 parts sand to 1 part flour makes a facing suitable for heavy castings. Also it is interesting to know that a facing of that type will produce a smooth casting in a coarse molding sand when a foundry is equipped with a No. 3 Albany, for making all heavy castings is confronted with the necessity of making a few small castings such as name plates. We suggest that you equip your brass foundry with a grade of molding sand such as No. 1 Albany, as this is the best all-round grade of molding sand for brass molding. It will make both small and heavy castings up to 100 pounds weight at least.

Q & A

Casting German Silver

Can you instruct us in regard to the molding and casting of German silver? Our trouble is to get clean, sound castings. After machining we find holes that seem to be caused by dross. The castings are stove legs and must be polished. We use a mixture of 50 per cent German silver clippings and 50 per cent German silver scrap, and we add 1½ pounds of 50-50 silicon-copper and also 3 ounces of magnesium to 100 pounds of metal. In pouring we aim to keep the sprue filled all the time the mold is taking metal, and we use a long heavy runner with branching gates.

German silver scrap generally contains aluminum, and if yours does, there will be drossing. The method of making the German silver is open to criticism, because you do not know what you are doing, and no two heats will be alike. It will be far better to buy ingoted German silver that has been alloyed and that will cast in sand without trouble. It will save money, and there are numerous excellent brands to choose from.

As far as the mixture is concerned that is now used, no control can be exercised over either the clippings or the scrap. In addition, 1½ pounds of 50-50 silicon-copper per 100 pounds of metal is entirely too much to put in. Use 1½ pounds of 10 per cent silicon-copper. A little magnesium will do no harm, but 3 ounces, is far too much. Cut it to one ounce. As far as the molding is concerned, follow the practice used with yellow brass. The pouring methods you give are correct, but a couple of skimming cores in the runner between sprue and gates will do no harm.

BRITISH FOUNDRYMEN *Cast* *Variety of Alloys*

Part VI—Nickel Alloys

Resistant Alloys

MANY corrosion and heat resisting alloys have been developed for use in industry. Some of the alloys are nonferrous, containing mainly copper and nickel. Others are ferrous alloys and contain chromium or nickel and chromium in varying amounts. In this article the author describes the corrosion and heat resisting alloys which are cast in the foundries of Great Britain. This is the sixth and concluding article of a series on alloys cast in Great Britain. The articles are from a paper presented at the meeting of the Association Technique de Fonderie de France, held in October.

By Thomas H. Turner

MANY modern alloys cast in Great Britain which possess remarkable resistance to corrosion, electricity or heat, form a fascinating study. They are difficult to review because of their complexity, lack of standardization, proprietary character, and, in some cases, experimental nature. In the main, they are dependent upon nickel for their resistant properties. Copper and chromium are often present in appreciable percentages, and tungsten, manganese, silicon and aluminum often are regarded as desirable additions in smaller quantities.

Lists Alloys Used

Alloys now cast for their especially good resistance to corrosion by the atmosphere, natural waters or chemicals, are: Cast nickel silvers; cast copper-nickel alloys; malleable cast nickel, cast austenitic nickel-chromium steels, and special cast irons.

Casting of the nickel silvers has been a steady business in the foundry for many years past, as these alloys are used in the form of harness equipment, buckles, motorcar fittings, and many such parts where a material superior to brass is required. In ordinary practice, the copper content is about 60 per cent, nickel between 7 and 20 per cent, and the remainder zinc, but great variety of compositions exist within these limits.

In the trade, the names and compositions given in Table XXXVI generally are accepted, but so far as one is aware, the first two grades are only used in the rolled or drawn conditions. However, the five grades shown in Table XXXVI are typical of cast nickel silvers.

For catering equipment and ornamental articles, copper-nickel alloys have become increasingly popular, the best known examples of these being the 55 per cent copper, 45 per cent nickel alloy, which has been cast with great success for all the ornamental metal work and window fittings of Imperial Chemical House, the finest of London's modern office buildings. It is only fair to add, however, that this alloy is much more widely used in the rolled or drawn conditions.

Though not a pure copper-nickel alloy, monel metal may be mentioned here, as it also is being cast by many foundries throughout the country. It is required in an admiralty specification to have a minimum ultimate tensile strength of 44,800 pounds per square inch, and at least 12 per cent elongation, but much better figures are obtained regularly in practice. Typical test figures for cast monel metal are: Tensile strength, 56,000 to 67,200 pounds per square inch; elongation on 2 inches, 25 per cent, and brinell hardness 110-140.

The high melting point of nickel and monel metal has entailed the mastering of a new foundry technique, but these alloys now may be seen cast in daily practice from a pouring temperature of between 1500 degrees Cent. and 1650 degrees Cent. Up to 2 ounces of magnesium per 100 pounds of monel metal, or nickel, is added before pouring, to deoxidize and desulphurize the melt. As monel metal shrinks ¼-inch per foot, a good head is necessary to insure sound castings. Since the metal is extremely brittle immediately following solidification, collapsible cores are essential to allow the casting to contract. The author only has seen these alloys melted, for foundry purposes, in coke fired crucible holes, but electric and oil-fired furnaces also are said to be in use.

Describes New Mixture

A new alloy with somewhat similar properties recently has been cast in a local foundry, although of American origin. This alloy, containing about 30 per cent nickel and 60 per cent copper, has a lower nickel content and lower melting point than monel, and is said to be easier to handle in the foundry on that account. Its mechanical properties are excellent at elevated temperatures. Specific gravity, 8.8; shrinkage, ¼-inch per foot; thermal conductivity, 0.060 calories per square centimeter per degree Cent., are some of its properties. Others will be found under the designation everbrite in Table XXXVIII.

Malleable cast nickel castings are

Table XXXVI

Nickel Silvers

Names accepted in the trade	Copper per cent	Zinc per cent	Nickel per cent
B. B.	53	17	30
A 1	55	20	25
Best	64	16	20
Seconds	60	25	15
Thirds	60	28	12
Fourths	60	30	10
Fifths	57	36	7

Table XXXVII

Compares Figures

	Maximum Magnetic Permeability	Specific Resistance Michroms/c.c.	Resistance Temp. Coefficient 0°C.-100°C.
Nonmagnetic	1.03	140.	0.00045
Ordinary Cast Iron	330.	95.	0.0019
Brass	1.00	7.5	0.00156

in regular demand for chemical plant and food machinery, and of the above alloys, nickel silver, silveroid, and malleable cast nickel are remarkably tough in the form of castings. Izod impact test figures averaged as follows: Nickel silver, 27 foot pounds; silveroid, 44 foot pounds and malleable cast nickel, 46 foot pounds in some tests which the author recently made on alloys supplied in the cast form, and none of the specimens were snapped in two by the impact.

Melting of the austenitic nickel-chromium steels follows along almost identical lines. The author has visited locally three specialist foundries, in which he has seen these new alloys cast. In one of them, in which nearly a ton of such castings is made a day, monel metal and the austenitic nickel-chromium steel are cast as required, from the special coke-fired furnace.

Ordinary cast iron is superior to mild steel in resistance to corrosion, and might almost be classed as a resistant material, but it is improved greatly by the addition of high percentages of silicon, and of nickel, copper and chromium. The former type is an unmachinable silicide; the latter a machinable fine grain gray iron. Both of these types of corrosion-resistant cast irons are now cast in Great Britain.

Alloys now cast for use as electrical resistances are: Alloy cast irons, and nickel-chromium alloys. Evidence has been lacking of any use of the relatively low nickel (5.0 per cent) cast iron resistance grids, which the author has seen cast in the United States, but nonmagnetic, austenitic cast iron grids are used. As pointed out in a previous article, a cast iron containing 10 per cent nickel and 5 per cent manganese is cast into electrical resistance grids of high specific resistance. This alloy cast iron compares with ordinary cast iron and brass as shown in Table XXXVII.

Some furnaces are at present being designed for electrical heating, in which the resistors are of a cast alloy containing about 60 per cent nickel and 18 per cent chromium. This alloy of American origin is now sand cast in Great Britain for many purposes, and will be considered in further detail a little later. However, it should be stated that at room temperature its specific resistance is about 117 micro-ohms per cubic centimeter and that it is used for furnace heating units due to its high strength and resistance to scaling.

Alloys now cast for use as heat resisting materials, to resist oxidation and to carry stresses at elevated temperatures, are: Nickel-chromium alloys; nickel-chromium austenitic steels, and special alloy cast irons. Use of nickel-chromium castings steadily has increased, but they do not monopolize the heat resisting alloy field. Where price is secondary to service, the nickel-chromium alloys still excel. Where first cost must be as low as possible, and service is less regarded, other alloys compete. This is particularly the case where known likelihood to sulphide corrosion exists.

Particulars have been received from foundries casting heat resisting articles in alloys rich in nickel and chromium as follow: One alloy contains 67 per cent nickel, 16 per cent chromium, 12 per cent iron, and remainder not specified. It has a brinell hardness of 235, an ultimate tensile strength of 71,680 pounds per square inch and an elongation of 2 per cent in 2 inches. Another alloy contains 60 to 65 per cent nickel, 15 to 18 per cent chromium, 1.4 to 1.8 per cent silicon, 0.6 to 0.8 per cent carbon, and the remainder iron with small amounts of impurities. It has a brinell hardness of 160 to 200, an ultimate tensile strength of 64,960 pounds per square inch or an elongation of 3.5 per cent in 2 inches.

The 67 per cent nickel-16 per cent chromium alloy is being cast into annealing pans, cyanide pots, fire-bars, burner nozzles, pyrometer tubes, carburizing boxes, and articles used for similar heat resisting purposes. Its melting joint is 1420 degrees Cent. and it has a specific gravity of 8.14. Though ten times, or more, as dear as the usual steels, its uses have increased steadily owing to its resistance to scaling.

Test pieces cut from a 60 per cent nickel-18 per cent chromium alloy casting, made in the course of usual work in the electric furnace, and pulled at temperatures increasing up to 1100 degrees Cent., showed little alteration in the mechanical properties until 700 degrees Cent. Above that temperature, the tensile strength falls off more rapidly to 6000 pounds per square inch, at 1100 degrees Cent., the elongation at that temperature being 20 per cent in 2 inches.

So far as the author is aware, there are no standard specifications for any of these resistant alloys, unless one regards silver solders as coming under this category, they being the most resistant of the solders and frequently used in electrical work. These are as follows: Grade *A* contains 60 to 62 per cent silver, 27.5 to 29.5 per cent copper, 9 to 11 per cent zinc, and the maximum impurities are limited to 0.5 per cent. Grade *B* contains 42 to 44 per cent silver, 36 to 38 per cent copper, 18.5 to 20.5 per cent zinc and the maximum impurities allowed are limited to 0.5 per cent.

Table XXXVIII

Cast Corrosion Resistant Alloys

Name	Usual Composition Per Cent	Brinell Hardness	Izod ft. lbs.	Tensile Strength lbs./sq. in.	Elongation % in 2 in.
Nickel Silver	Varies: Copper upwards of 60, Nickel 7-30, Zinc the remainder. Figures here given are for: Copper 64, Nickel 20, Zinc 16	75-80	27	44,800-56,000	35-40
Silveroid	Copper 55, Nickel 45, Manganese up to 1.00	90-100	44	56,000-60,480	45-50
Monel	Nickel 67, Copper 28, Iron 2.75, Manganese 1.8, Silicon 0.3, Combined Carbon 0.15, Graphite Nil	120-140	107-115	44,800-67,200	12-25
Everbrite 82	Copper 60-64, Nickel 29-31, Iron 6-8, Silicon 0.3-0.5, Manganese 0.25	170-200	.....	75,040	14
Malleable Cast Nickel	Nickel 99, Manganese, Magnesium, Silicon, Carbon traces	80-90	46	62,720-67,200	50-55
M 1 Stainless Steel	Carbon 0.14-0.16, Manganese 0.28-0.31, Silicon 0.04-0.24, Chromium 17.8-18.0, Nickel 8.0- 8.3	175	.....	107,520	50

How We Secured SAFETY

By George A. Seyler

SAFETY is the natural result that may be expected from a certain effort that is put forth. A lot of people say "Oh, we haven't had any lost-time accidents." They whisper, and they touch wood. They might as well shake a rabbit's foot; they'd get the same results. Safety is the result of certain definite things that are done in industry; profits are the result of things that are done in industry. Do you shake a rabbit's foot for profits? When a man wishes to turn out a quality product does he whisper and touch wood to get it?

When we start out with quality or with safety or with any other thing that we want to accomplish, we find out that it is a matter of education. Where do we begin? Do you ever stop to think it all out?

Signs Did Not Work

Years ago we tried signs. We hung up all the pretty signs, *Be Safe—Look Out for Your Neighbor*, etc.; but that didn't do the trick. For a while I thought it might—even thought we didn't have enough signs, but we found out that the more signs we put up the less they were regarded—and of course, if they stayed up long enough they got rather dirty. We still use signs but we don't use them as a main punch; they are only a reminder. The main punch starts with education of the foreman, the keynote in the safety movement. What is this education? The foremen meet once a month and part of the program is safety. Three-quarters of an hour or an hour is devoted to that subject.

When they came together the foremen were told that each man represented at least 15 years of experience on any subject pertaining to their work, because they had lived in it and had worked in it. They had personal experience. There is nothing more valuable than to get the combined experience of all those men—ten men, representing 150 years of experience in accidents. Here are some of the things that they said, frank opinions of their own.

"It is the duty of every foreman to investigate every violation of the safety rules, whether the violations have resulted in accident or not." If a man is careless with a dirty gangway or improper stacking of product in a plant, or things of that kind, whether anybody is hurt or not, we consider the violation of the safety rule the important thing.

What did the foremen say further? "It is the duty of the foreman to do all he can to prevent accidents by being on the alert all of the time to prevent accidents, and by taking steps to prevent the recurrence of an accident when it occurs." When an accident happens in our plant we do not say, "How did this accident happen?" but, "What caused the accident?" Because they say further:

"Accidents are preventable and can be prevented to great degree by the foreman exercising constant vigilance." Eternal vigilance is the price of safety as well as analyzing sources from which injuries come.

The foreman say that, "No individual has the right to authorize or even encourage action which may jeopardize life or limb." No individual has that right. Another thought is as follows: "There are two agents of safety precaution. One is mechanical—guards on machines and so forth; and the other is human, living-and-acting safety." You cannot hire one man who can guarantee that as long as he was on the payroll there would be no accidents. A lot of people would be glad to have men like that in their plants. The company would save money and the management would have a lot of worry taken off their minds.

Why are we all worried about safety? It is not an easy but a difficult job. That is the reason we are concerned. We all have to live and act safety. We must be genuine in this safety work. We cannot get up and make a flowery speech on safety and then go out and be careless.

Enforce Safety Orders

The crux of our safety work lies in the next thought. "Enforcement of rules and orders on safety should be uppermost in the minds of all foremen. To violate orders of this nature is the same as violating any other order, which of course, is not tolerated." There is the crux. Violating a safety order is no different than violating any other order in your plant. What do we mean by that? Do you permit promiscuous late-coming? Do you permit fighting in your plant? You might dismiss two men who did either of those things. Another man, although he is not a fighter, and never tardy, will disregard the use of safety measures which you have put in the plant.

Another thought was summed up something like this: "All safety begins with the foreman, but unless it is carried concurrently to the assistant foreman and to the men, we cannot expect the desired results to be forthcoming." The foremen said: "The men will put importance on only those things that we ourselves (as managers) put importance on."

So when we consider the entire problem, we find that it begins with the management and ends with the management.

Harry W. Leighton Co., 565 West Washington boulevard, Chicago, has been organized with Harry W. Leighton as president and general manager and Mr. Thurber as vice president and secretary. That company is representative for the Buckeye Portable Tool Co., Dayton, O., and several other companies.

Interests Management

IN THE constant battle for safety in industrial plants, the management usually is interested in how other companies follow through on safety campaigns. While the foreman is the keynote to any safety movement in industry, the author places the responsibility of proper foremen training upon the management. The article is abstracted from a paper presented at the annual safety congress of the National Safety council, which was held in Chicago, Sept. 30 to Oct. 4. The author is works manager, Lunkenheimer Co., Cincinnati.

Brass Castings Offer Economical Engineering Materials

By J. B. MEIER

IT IS not with entire satisfaction that the average brass foundryman has watched the progress of forgings steadily encroaching upon his easiest, as well as most profitable casting jobs. It is not without a proper appreciation of the relatively superior qualities of the forging that has caused him to permit one after another of these jobs to slip away. Neither has he been ignorant of the subtle and seductive reasoning regarding ultimate costs which has seemed to clinch an almost conclusive argument on the question.

Problem Needs Thought

For, is not a brass forging superior to a sand casting as far as appearances go? Doesn't it polish easier and cheaper? Doesn't it fit chucks and jigs more accurately, and machine more easily? It does all these, and more also. Perhaps considered more important still, it relieves the production manager of many worries and petty annoyances, which loom large to an already over-burdened official, who is unfamiliar and often unsympathetic to the problems of making castings, so that it is with joy he welcomes the forging whenever he can.

As an expedient, it may help out in a season of great production, but how about the periods of moderate production, and more important, periods of depression? The problem is not the same, by far, for few forgings are furnished to the customer in exactly the same condition as castings. Invariably, they are semi-finished, and often completely finished. Of course, it is assumed that the cost department has determined that whatever condition they are furnished in, it is at a lower cost than the castings can be put in the same condition. Invariably the cost is figured with the full share of overhead on the castings, which is as it should be. However, it is this fact that is so important to the purchaser of forgings, because most purchasers already have invested in buildings or rented space, purchased equipment and facilities for manufacturing.

What actually takes place when such a purchaser buys forgings at any time, other than when he is pushed beyond the capacity of his plant, is that he is permitting his equipment to stand *idle* while he encourages some forging manufacturer to increase his working efficiency, or enlarge his plant. It is at this time, which is often 75 per cent of the year, that a reanalysis should be made on castings versus forgings. Often the actual saving of forgings over castings is more mental than anything else, and is measured in management problems and efficiency, rather than dollars.

If a casting can be purchased for 7 cents and machined for 2½ cents for labor and costs, with another 3½ cents for overhead, making a total of 13 cents, is it cheaper to buy castings or to buy forgings at 12 cents, 11 cents or even 10½ cents when you have the equipment to handle the casting and are laying off machinists because you have no work for them to do?

Needs Serious Thought

Has every manufacturing purchaser of forgings given this feature of the problem the serious thought it deserves? What if castings do require more supervision, the foreman usually is paid the same salary whether he has 15 or only 7 men under him, during a period of slackness, so the cost is mostly on the foreman and not on the factory. To the writer it seems as if most of the purchasing of forgings is pushed by the man it hurts the most.

While this is the most important factor to be considered, there are others which invite consideration. How about the manufacturer who makes 10,000 or 20,000 pieces and changes his design, or would like to change his design? Did he figure the cost of dies on these quantities, or did he anticipate several hundred thousand without a change? How does the cost of a plate of patterns and corebox compare now with dies? Do many purchasers of forgings know that the life of a plate of patterns is usually 10 to 20 times the life of a set of dies, and only costs from ¼ to 1/10 as much?

Many minor changes can be accomplished easily at practically no cost on patterns which would involve an entirely new set of dies, and most manufacturers are familiar with the constantly arising necessity of minor changes, even though long years of manufacturing have passed.

Has Resale Value

Another item, that is often overlooked, is the fact that castings have a certain amount of waste which has a resale value, running from a minimum of 5 per cent to as high as 15 per cent of the initial cost of the casting. This feature either is ignored entirely or not applied to the particular item in question, but dumped in a general account. To the finished forging there is no redeemable waste, and therefore, its purchase price is its cost.

The foundry seldom is consulted. Blueprints hardly ever are submitted whereby suggestions might be made as to methods of design for cutting down the weight. The forging producer always is furnished a blueprint, and often forces changes in design to bring the price down. This causes considerable annoyance to the purchaser, if not additional expense elsewhere. Recently it was the author's good fortune to be in a manufacturer's office when a question of forgings versus castings came up on a particular item. The price on a stock forging for this item was 6½ cents apiece. Castings for this item had cost 7½ cents, so it looked bad for the castings.

After further investigation it was found that while the stock forging was a perfect part, the casting was not designed at all for this job, but would have been used because the pattern equipment was already in service

on another job. Refiguring upon a design suitable for the job in question it was found that the casting could be reduced in weight from 4 to 2½ ounces. This was a reduction in cost on the casting of 1⅞ cents with an investment of $35 in pattern equipment, on an order of 10,000 pieces; with every prospect of a repeat order about every 90 days. Figuring only on the initial order, it would cost roughly ½-cent for pattern, or the cost of the casting was now 5⅞ cents, against 6½ cents for a forging. No allowance was made for additional saving in machining cost, although it was acknowledged by the purchaser that there would be a recognizable one; neither was the resale value of the turnings figured. These considerations lowered the cost of the casting.

So, in conclusion, the writer believes that if every purchaser of forgings and castings will take all the factors in consideration, and give the foundry the same opportunities as his competitors, he often will save money by buying castings in preference to forgings, and further will keep his men employed at a profit to his plant.

Floodlighting with Cast Aluminum

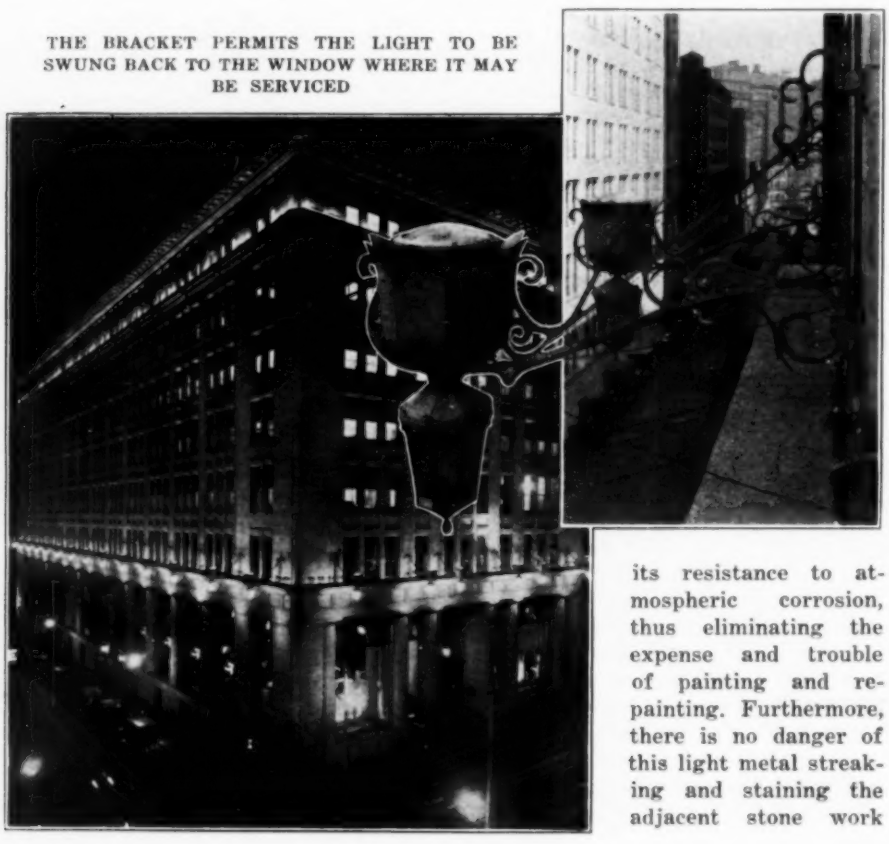
A FLOOD-LIGHTING system, recently installed by the Duquesne Light Co. on its building in Pittsburgh, is a departure from the usual method of illuminating the exterior of a vertical building having no set backs. In the past the floodlights for such a building have been placed on the adjacent buildings, necessitating not only the consent of the owners of these buildings but a multiplicity of electrical control and service as well.

On the Duquesne building, the flood lights are held in place by brackets mounted on the face of the building at the third floor level. At the end of each regularly spaced bracket, there is a projector, in the form of a lotus flower, and a suspended lantern. The projectors contain 1500 watt lights, and throw a pillar of light upward against each pilaster meeting the rays of light coming from the solidly illuminated top floor and cornice. The hanging lanterns contain five hundred watt lights, and provide general illumination for the ground floors and side walk. There are 25 such units. Each unit is hinged, and may be swung to the building so that it can be serviced readily from the windows.

Each flood-lighting unit is fabricated from nine architectural aluminum castings. The bracket is cast in one piece. Four bracket support castings hold the bracket in place. Two of these are attached to the building, and the other two are bolted over the bracket. The suspended lantern is cast in three sections, and bolted together. The lotus flower projector is cast separately, and attached to the bracket. To eliminate the chances for electrolysis, the bolts are also of aluminum. The entire assembly weighs less than 200 pounds.

Aluminum was selected because of its resistance to atmospheric corrosion, thus eliminating the expense and trouble of painting and repainting. Furthermore, there is no danger of this light metal streaking and staining the adjacent stone work since it does not form salts which can in any way discolor the building.

THE BRACKET PERMITS THE LIGHT TO BE SWUNG BACK TO THE WINDOW WHERE IT MAY BE SERVICED



Publish Congress Report

The Chicago Foundrymen's club, through the courtesy of the Whiting Corp., Harvey, Ill., has published a report of the trip to the third International Foundrymen's congress in London, presented by R. S. McPherran, chief chemist, Allis-Chalmers Mfg. Co., Milwaukee, before a recent meeting of the club. The report deals with cupola practice in Europe, especially England and Germany. The author also describes the process used to make a special iron known as perlit and gives its properties. A part of the report deals with mold practice and the growth of the various patented irons under high temperature service conditions. The author gives some data on the wear test as applied to irons used for diesel engine work. The bulletin includes micrographs of irons made in England and in Germany.

Wins Apprentice Contest

Ronald Eyrich, apprentice, Allis-Chalmers Mfg. Co., Milwaukee, was winner in the annual drafting contest for apprentices conducted by the Milwaukee branch of the National Metal Trades association. Second place was won by Arthur Nolde, Falk Corp. and third place by Edgar Sundby, Nordberg Mfg. Co. Harry Zarek, Allis-Chalmers Mfg. Co. and Bernard Schneider, Chain Belt Co. received honorable mention. Judges of the contest were E. H. Bruce, Kearney & Trecker Corp.; M. Smith-Peterson, Nordberg Mfg. Co.; F. Schmidt, Allis-Chalmers Mfg. Co. The contest was arranged by a committee composed of W. J. Gibson, Harnischfeger Corp.; C. J. Freund, Falk Corp.; M. J. Dalton, Chain Belt Co.; George Havlista, Kearney & Trecker Corp, and R. W. Cox, National Brake & Electric Co. The contest was held in the rooms of the Milwaukee Vocational school.

The FOUNDRY Family Photograph Album

Upper Left

J. H. WATTERS

Marion Steam Shovel Co., Marion, O.

Upper Right

J. H. FRANCIS

Kilby Mfg. Co., Cleveland

Lower Left

P. R. DIAMOND

Canadian Bronze Co. Ltd., Montreal, Que.

Lower Right

W. McFADDEN

Chicago Crucible Co., Chicago

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

HINTS FOR THE CORE ROOM

(*Continued from Data Sheet No.* 796)

Dextrine

Specific gravity: Approximately 0.47; Average weight per gallon 3.9 pounds.

Composition: Dextrine is one of the constituents of grain flour.

Mixing instructions: Add binder to sand and mix thoroughly 2 to 3 minutes. Add tempering water (about 8 per cent by volume) and continue mixing 5 to 7 minutes longer. Sand, bond, and water should be measured accurately and mixing done in a mechanical mixer to insure the best results.

Baking conditions: The recommended baking temperature is 350 degrees Fahr. Care must be taken not to overbake as above 350 degrees Fahr. the bond deteriorates rapidly and at about 500 degrees Fahr. it is decomposed.

Use: Dextrine is seldom used alone as a binder. It is often one of the constituents of the commercially compounded dry binders. It works well with pitch and counteracts somewhat the tendency of the pitch to coke during casting.

Core mixtures:

Small intricate cores for gray iron.

60 parts open clean silica sand.
5 parts new molding sand.
1½ parts good grade core oil.
3 1/3 parts dextrine.

COLLOIDS

Clay

Specific gravity: 1.0 to 2.0 (loose); Average weight per gallon 8.5 to 17 pounds.

Composition: Clay is a mixture of hydrous silicates of iron, aluminum, and magnesium. The natural molding sands contain from 8 to 20 per cent clay.

Mixing instructions: Clay bond always is added to the sand and thoroughly mixed before other bonds and tempering water is added.

Use: Clay bond is never used alone for dry bond, but is used with pitch, paste binders, molasses, and the sulphite liquors. Clay sometimes is added to an oil-sand mix but it generally is not recognized as good practice. Small amounts of clay in the mix greatly increase the bond consumption. The particles of clay are fine and therefore greatly reduce the permeability (venting qualities). Clay also readily draws moisture and is therefore undesirable for core mixtures. Clay is added to give green bond, and to give a smooth surface to the core. Clay should not be used with oil but with such binders as molasses, and glutrin it works quite effectively. When used with binders of the glutrin type it prevents to a

(*Continued on Data Sheet No.* 798)

HINTS FOR THE CORE ROOM

(*Continued from Data Sheet No.* 797)

considerable extent the migration of the binder to the surface of the core. Clay bond core mixtures are used to some extent for ornamental work where smooth surfaces are required. It is used for both green and dry sand molding.

Core mixtures: Clay bonded sands are used for green sand cores. For this purpose the clay content in sand is usually a little stronger than for the ordinary molding sand and should be thoroughly mixed and aerated. A clay bonded sand with a small amount of corn flour, dextrine, or pitch and dried at a low temperature (250 degrees Fahr.) gives a semi-dry core which must be handled with arbors the same as green sand cores. This type of a mixture is being used on small hand water pump stands.

Molasses

Specific gravity: 1.25 to 1.35. Average weight per gallon 10.5 to 11.5 pounds.

Composition: Molasses is a residue product from the sugar industry.

Mixing instructions: Molasses is seldom if ever used alone as a binder because at the temperature at which the bond is developed there is temporarily no binding power at all which results in sagging and the collapsing of the cores. Therefore, it is used with other binders as well as a binder for paste, core wash, and facing sand mixtures. Molasses water as used around the foundry is a solution of molasses in water in about the ratio of 1 part molasses in 15 parts of water. In this form it frequently is used as tempering water with many mixtures, especially those using a dry bond and old sand.

Baking instructions: To produce a dry bond a temperature of 250 degrees Fahr. is required. At this point it changes to a sugar which imparts the dry bond, but during this interval while changing from molasses to sugar its bonding property is temporarily destroyed resulting in sagging or the collapse of the core.

Use: Molasses is sticky and is used to impart green bond. It is used to advantage with dry binders and old burnt sand. Molasses draws moisture readily and cores containing molasses must not be stored in a damp place or allowed to stand in a mold any length of time.

Corn Sugar Molasses:

Specific gravity: Approximately 1.4, Average weight per gallon 11.7 pounds.

Mixing and Baking instructions: The mixing and baking instructions are the same as for ordinary molasses. It is a much stronger bond and therefore requires a corresponding lesser amount. It can be used any

(*Continued on Data Sheet No.* 801)

Bill Makes a Plea for Industrial Peace

By Pat Dwyer

HAD I not a general working knowledge of the manner in which mailing lists are made up and circulated I might have felt flattered the other day when I received a handsome invitation from the manager of a new hotel to take up my residence with him. He assured me—in his blissful ignorance—that as a rising young business man accustomed to and appreciative of the finer things of life, I would find the surroundings congenial. Deftly and smoothly he intimated that my social and business success would be enhanced greatly when my friends and acquaintances learned that I resided permanently at the Hotel Eldorado.

Among many attractive features he directed my attention particularly to the beautiful white and green swimming pool, 40 feet from side to side, 100 feet in length and with a depth of water ranging from 3 to 7 feet. This water was changed twice a day and was carefully tested, inspected, sterilized, strained and—I believe— fumigated, before it was allowed to enter the pool. It was maintained at a temperature of 70 degrees Fahrenheit in winter and a person with even the rudiments of an imagination could close his eyes and fancy that he was basking in the coral pool of some dreamy, enchanted South sea isle.

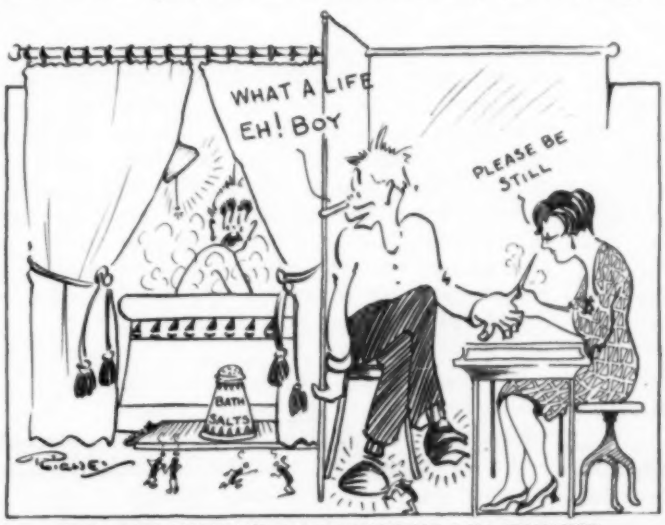
Through a regrettable oversight he forgot to mention the perfume and the bath salts. Had he included these items I might have considered the offer favorably, but under these conditions I turned it down flat. In imagination I could see myself blushing with deep humiliation when a friend invited to take a dip with me would turn up his nose and remark in pained surprise. "What! No bath salts!" I simply could not do it. His scale of prices per week bore a fairly close resemblance to the figures on the upper end of a thermometer. I have no fault to find with the room and board in my present humble lodgings, but as I say, the bath salt feature was the deciding factor in my refusal to accept the invitation. Just another instance, dear children, of how weighty decisions sometimes are affected by a trifling matter.

Association of ideas rolled away the long scroll of years and showed me the hot August sun shining on the placid bosom of a deep tidal river where a band of young urchins spent the greater part of their waking hours and where they were as much at home as so many young seals. Their bathing costumes also bore a striking resemblance to the suits worn by these frolicsome and slippery creatures.

Stripping for action was a simple operation in those far away, golden, halcyon days. The cap was thrown on the grass 50 yards from the edge of the river. The shirt was pulled over the head and flung to one side while the hero dashed forward, and the pants dropped by gravity a few steps before the owner bounced on the springboard, rose in a graceful arc and then shot head first into the water as slick as a greased pig at a fair.

Occasionally a rumor drifted in, as rumors have a habit of drifting among people of all walks and conditions, of people who donned bathing suits before they entered the water. The majority of the gang treated these rumors with frank and skeptical disbelief. The more credulous members admitted that the rumors might be true, but if so, they pitied these misguided creatures silly enough to encumber themselves with a mass of soggy, clinging garments. In those days a bathing suit was about as light and comfortable as the suit worn by a deep sea diver. The only items missing were the lead soled shoes and the air hose.

A level green meadow extended from the river bank back for about 50 yards to where a dense growth of trees served as an effective screen to any person passing on the high road. Traffic was light in those days and for all practical purposes our sylvan retreat was as secure and secluded as the ornate pool in the Hotel Eldorado. In strict justice it must be admitted that this feature was not appreciated at its true worth. I am inclined to the opinion that this particular section of the river bank would have enjoyed our full and enthusiastic patronage had there not been a tree within 40 miles. Lying or rolling luxuriously in the warm scented grass where the sun tanned our naked little hides to the hue of the noble red man, we dreamed the long, long dreams of youth and built many a noble castle in Spain. Occasionally in later years I have watched groups of small boys and marveled at their constant chatter. With their limited mentality, lack of background and absolute ignorance of the future, what on earth do they find to talk about? From a more or less limited and outside experience I have



THE OLD BOYS MUST BE STEPPING OUT TONIGHT

gathered the impression that the female of the species, of any age from two to one hundred, can keep this exercise up indefinitely, but if a group of average men is confined in a room for an hour, they are absolutely talked out.

Offhand, with one exception, I cannot recall what weighty subjects engaged the attention of our little group. This one exception remains in my mind, probably because it came up so often. The topic always was introduced with the question: "Do you know what I would like to do if I had a million dollars?"

In these modern days the figure probably has been raised to ten, and by some real ambitious lads, to one hundred millions, but in these faraway days, a single million practically bounded the limits of imagination.

The fact that none of us ever had seen the owner of a million, that we probably never would see one and the further fact that our respective fathers only drew down a modest wage ranging from $1.10 to $2 a day, calmly was ignored as a factor of no consequence. What's a million dollars one way or another, when the heart is young, when the long years stretch ahead to the far away and enchanted horizon and when the immediate cares for the day, food, clothing and shelter lie on the mind as lightly as they lie on the birds of the air or the well known lilies of the field. True, the aforesaid lilies had the edge on us, slightly, in the color and texture of their raiment, but that was a detail of little importance to a gang who went barefoot from June to October, who spent the greater part of the summer vacation naked, in and out of the river and who wore a minimum of clothing, under protest, for the remainder of the year.

The other night I told Bill of the invitation I had received to take up my permanent residence in the Hotel Eldorado and of the train of thought that followed in the wake of the receipt of the invitation. I admitted that the idea appealed to me, but the fatal omission of bath salts from the list of attractions had forced me to turn the offer down. Incidentally and merely as a trifling after thought, I admitted that the financial feature had tinged my decision to a slight extent.

"Bath salts!" Bill cried in derision. "The next thing you will be wanting will be a menial to draw your bawth for you and a second menial to towel you after the ceremony and anoint you with some kind of fancy googum in the faint hope that it will take the wrinkles out of your hide.

"Bathing is all right in its place. As a factor in keeping the body clean and healthy it is more or less of a necessity. I say more or less, advisedly. I have known men who openly boasted that outside of an occasional spill in a river, or a drenching in a rain storm, they never had been washed all over at one time since their mothers sloshed them around in a tin pan and then put them away to dry, wrapped in an old plaid shawl. I had one of these lads for a helper one time. He claimed he was 70 years old—I know he had a grownup family—his hair still was black and luxuriant and he was as quick in his movements as any man in his early twenties and as strong and hard as an oak plank.

FROM FAMOUS OLD SONGS *THE CAMELS ARE COMING*

"This bathing stuff reminds me of the tramp who rambled into a camp one night out in the great open spaces where a party of wealthy men was resting after the fatiguing hunting exercises of the day. Every man in the party with the exception of the tramp was a semi-invalid of some kind and the talk turned on the relative merits of various medicinal springs all over the world. In turn each related his experience and mentioned the last time he had bathed in this or that spring.

"A few claimed that they had received benefit from the healing waters while the others claimed that this belief in the idea of a spring healing a man was just so much baloney. Finally one of the party asked the tramp if he ever had any experience along the line. The question was asked more or less facetiously, but the bum was equal to the occasion.

"'Why, yes,' he admitted modestly. 'De foist an' last time I tuck a bat' wus in de spring of '98 an' I ain't never been sick a day since!'"

"The daily bath," Bill continued, "is commendable and in some forms of occupation is a necessity, but in these cases a bather uses plenty of clean water and plenty of soap. That form of bathing is far removed from the practice we hear and read so much of in recent years, where bathing has been elevated to a sort of holy religious rite. The bather creeps into a tub full of warm water, sweetly saturated and scented with bath salts and lounges lazily there for an hour at a time indolently reading or maybe eating a few apples." "Where did you get all this inside information?" I inquired, curiously. "Don't tell me that by any chance you are a disciple of this new school." "Not likely," Bill replied scornfully. "In the first place I know blinkin' well if I stayed in a vat of hot water for an hour the soles of my feet would resemble two pieces of tripe and that is a pretty poor foundation for a man who has to tramp around a foundry all day. What a man in a foundry really needs is a pair of hoofs like those on a camel. Something with pads on 'em, insensible to heat, cold and moisture. Something to which the sand will not stick or work down between the toes.

"Well meaning and humanitarian men have developed safety shoes and leggings for foundrymen. What the foundry really needs is an industrial Burbank who will produce a molder equipped with a pair of camel's feet. The problem is not so difficult as it may appear at first glance. The molder already has the hump on his back. His knees are heavily calloused. The snap flask molder lifts more weight in a day than any camel ever carried in a month across the burning Sahara, over the wind swept desert wastes of Arabia or down the wild mountain passes from the roof of the world in the train of Ghengis Khan and Tamerlane.

"You hear a lot about the ability of a camel to plug along and breathe in the swirling sand storms of the desert. The molder breathes sand filled air as readily as any camel, in-

hales it at a higher temperature and in addition sucks up smoke, blacking and gas from burning cores, molds and salamanders.

"The superiority of the molder in this respect is offset by the ability of the camel to go seven days without a drink. However, I have no doubt that a race of molders easily could be developed to go through a drought of seven days periodically, if they were guaranteed the camel's privilege of filling the old tank to capacity on the seventh day.

"In the old days I knew many men who could qualify on this camel like attribute. The old boys, the home guards, held in subjection by matrimonial ties and one thing or another, managed to gasp through the week with their tongues hanging out and with their throats gradually closing with an accumulation of dust and grit. Came payday, in the classic language of the silver screen and these old lads indulged in a general sluicing comparable on a modest scale with the tidal bore in the bay of Fundy. The young lads, the gay cats, with iron kellys cocked low over one eye and with a trowel and a double ender constituting their entire tool kit, had more time and money at their disposal and as a result their per capita consumption of spirituous and malt liquors was on a more generous scale. The old lads came in sick and repentant the morning after payday, but the young ones were in a truculent mood most of the time. The old time gaffer had more trouble maintaining peace in the shop, than he had in getting out the work.

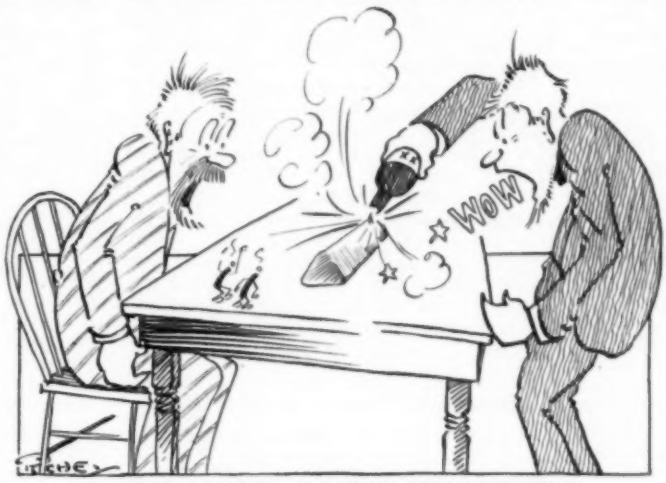
"With the closing of the saloons, most of the old soaks either have died a natural death or have been poisoned. Under the pitiful impression that their sand lined stomachs were as immune as a pickling tank they filled them to capacity with a brand of hooch that would eat its way through a granite block.

"Some of the younger members of the ancient craft still persist in their ambition to drink the country dry. They devote all their spare time to this hopeless task and their thoughts stray along the same line while their hands and feet automatically go through the motions of making molds.

"A friend of mine in Philadelphia recently referred cleverly to this type as the *hoof and mouth molder*. He hoofs it in the sand all day and at night exercises his mouth in condemning everything in connection with the foundry, particularly with the foundry in which he is at present employed.

"A foundry is no bed of roses. It is no place for the unfit, the incompetent, the lazy, or the man who thinks the world owes him an easy living. The same is true of every form of manual occupation and dissatisfied men are to be found in every walk of life.

"Thousands of men work in the foundries of this country. They are satisfied and contented. Taking the molders trade by and large, year in and year out, men earn more money than other tradesmen. Through the introduction of mechanical equipment, the manual labor involved in the production of castings has been greatly reduced. Modern foundries are clean, light and airy, cooled in summer and heated in winter by a ventilation system that also removes smoke and dust.



TECHNICAL TERM: APPLYING THE ACID TEST!

"The hoof and mouth molder will not admit any of these things. He has no knowledge or conception of former conditions and persists in believing that the capitalists iron heel continually is grinding him into the dust. He spills maudlin tears in his beer mug and informs all and sundry that his present employer is a combination of Simon Legree, Judas Iscariot, Nero, bloody Jeffries and a Comanche Indian and he strongly suspects he is of canine ancestry.

"'So help me,' he will say, 'I have woiked in every shop from here to de coast and back again and I never seen a dump like dis. It sure gets on me noives. If youse guys would take my tip, youse would walk out on the old bum an' leave him flat.'

"The peculiar feature is that he always refuses to consider himself merely as an individual with a grievance. Automatically and perhaps unconsciously he elevates himself to a position of leadership, a modern Moses whose mission in life is to lead his associates out of bondage. The fact that they have evinced no desire to be led or carried out of bondage, calmly is ignored.

"Foundry owners, almost without exception are mindful of the well being and comfort of their workmen. No foundry owner is in business for his health or for the pleasure he may derive from it. The rigid economic law of supply and demand regulates his costs and selling prices. His costs include materials, labor and overhead and of these three, the cost of his labor is the least elastic. Living conditions, and not the arbitrary will of the employer is the deciding factor in any given district. Labor turnover is an expensive feature in any organization and common sense would seem to indicate that a manager's best interests are served by a policy which carefully avoids any causes of friction. This fundamental factor of successful management is so well understood that many of the larger employers of labor delegate a man whose duty it is to interview every man who has been discharged, or who voluntarily resigns his position. This man conducts an impartial investigation in every case, with a view of either adjusting any misunderstanding, or of transferring the workman to another department where conditions may be more to his liking.

"So long as men are men, actuated by the ordinary frailities of the human race, differences of opinion occasionally will arise over certain clauses in any bargain. This is inevitable and is characteristic of any kind of bargaining. In practically every case these differences can be adjusted amicably if both parties get together with a view of comprehending each other's view point. Unfortunately we still appear to be a long way from Utopia and nations as well as individuals seem inclined to favor a silly recouse to force of arms. All the hoof and mouth boys are not in the foundry."

Leeds & Northrup Co., 4901 Stenton avenue, Philadelphia, recently celebrated the opening of a new addition to its plant with a minstrel show and dance at the Elks club. The new addition is the largest made to the original building, erected in 1903. The floor space now exceeds four acres.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Study Effect of Graphite Formation

Der Einfluss der Graphitausbildung auf die Sauereloeslichkeit verscheidener Gusseisensorten, by Peter Bardenheuer and K. L. Zeyen, *Die Giesserei*, Duesseldorf, Germany, Nov. 8, 1929.

The authors investigated the influence of the graphite formation on the acid solubility of different types of cast iron to determine its effect. Test pieces were made from cupola iron and that melted in a high frequency electric furnace. The electric furnace iron was made from Swedish charcoal pig iron with additions of steel scrap, ferromanganese, ferrosilicon and ferrophosphorus to provide any given composition. Metal in the electric furnace was heated to about 1400 degrees Cent. (2550 degrees Fahr.) and poured at 1350 degrees Cent. (2460 degrees Fahr.) Cupola metal pouring temperature was 1300 degrees Cent. (2370 degrees Fahr.) Test pieces were cast in green sand, dry sand, chills, and heated molds to obtain different graphite formations. The specimens from the chills or iron molds were annealed for 6 hours at 850 degrees Cent. (1560 degrees Fahr.) and slowly cooled.

Specimens from the various lots of iron made were immersed in normal hydrochloric acid, normal sulphuric acid and normal acetic acid. Results showed that the finer the graphite formation, the greater the attack of these acids. It does not make any difference whether the fine or coarse graphite structure has been obtained through temperature or condition of the mold, through a different thickness of casting, or through different degrees of superheating the melt. Test pieces with a casting skin behave the same as machined pieces. The results obtained are reconciled with the local element theory because with finer graphite, the number of graphite particles and thereby the number of local elements are greater.

Speaks on German Melting Practice

Thoughts on Modern Melting Methods, by N. D. Ridsdale, *Foundry Trade Journal*, London, Oct. 31, 1929.

In referring to melting practice as observed by the author on a recent visit to Germany, he compares the Brackelsberg furnace with a modification known as the Buess furnace.

The Brackelsberg furnace originally was designed to produce malleable iron, but high test gray iron also is produced in it. The furnace rotates on rollers at the base while in operation and may be tilted to a 50 degree angle for charging. It is fired with powdered coal ground to 170 mesh and introduced into the furnace at a pressure of from 10 to 13 inches of water. The air can be controlled to give either a slightly oxidizing or reducing flame. A 4-ton charge of gray iron was melted in 2¾ hours which is reduced sometimes to 2¼ hours. Metal losses are approximately as follows: Carbon 0.11 to 0.18; silicon, 0.25 to 0.40 with 4 per cent silicon; and manganese, 0.02 to 0.07. Sulphur showed a gain of 0.001 to 0.004. Total losses were from 0.62 to 1.22 per cent. Coal consumption was 14 per cent of metal when melting malleable and 12 per cent with gray iron.

The Buess furnace also operates on the pulverized coal fired, rotary principle. The chief difference between it and the Brackelsberg furnace is in the method of rotation. The furnace is mounted eccentrically at the ends and when rotated gives a swirling action to the bath. Claims for the furnace include thorough mixing and quick melting.

Another foundry was equipped with blast furnaces which supplied molten metal of desired analysis to two 150-ton mixers. One of these supplied metal for light and the other for heavy section castings. A number of cupolas known as Poumay cupolas are in operation in Europe. Many Greiner cupolas also were found. These cupolas introduce the blast at various levels in the shell. Large savings in coke consumption and minimum oxidation of the metal are claimed.

Describes Foundry Organization

The Outlook of Metal Castings, by Leon Thomas, *Bulletin de l'Association Technique de Fonderie*, Paris, August, 1929.

The author divides his paper into five parts: Scientific orientation of the foundry, rational orientation, social orientation, mass production methods, and foundries making a diversity of work. The first part reviews the progress made in the scientific investigation relating especially to foundry practice, from the constitution of cast iron and the study of special irons to the study of sands. It deals especially with the operation of the cupola, drying ovens and heat-treatment furnaces.

The second part deals with the organization of the foundry. The author emphasizes the point that organization is above all the application of good sense to the study of the particular conditions under which a given foundry is working. The use of machines for molding and coremaking, the study of the modern requirements of raw materials, the even flow of products from the raw material to the finished casting and the various steps in fabrication are passed under review and illustrated.

The third part deals with the labor question. The author states that the exploitation of a foundry can only be profitable through employment of efficient labor. The methods necessary to obtain this efficiency are explained, and importance is given to the management of the foundry and the relations between management and workers. Wages and welfare work are taken into consideration.

In the fourth and fifth parts the author shows the application of the principles passed under review, as it is done in a number of existing foundries. Mass production methods are discussed in the course of brief descriptions of the Singer foundry, Elizabethtown, N. J.; the American Radiator Co., Buffalo, and the Grabler Co., Cleveland. Short descriptions with plans of certain other foundries also are given to illustrate methods used for diversified production.

Many Factors Influence Permeability

Foundry Sands, by Professor Nipper, *Bulletin, Association Technique de Fonderie de Belgique*, Brussels, November, 1929.

The author limits himself to the study of the relations between permeability, structure of sands and methods of molding. He states that only two devices for testing the sand permeability are in existence. One is the American Foundrymen's association machine, in which air flows from a reservoir through a certain thickness of sand, and the difference in pressure gives the measure of permeability. The other apparatus is the one used at the Aix-la-Chapelle institute, in which a certain amount of sand is jolted mechanically and a certain quantity of gas flows through the mass of sand. In that apparatus, the pressure is measured.

The author gives a number of diagrams showing the variations of permeability under various conditions. He shows that permeability increases with the size of the grain. If the sand is composed of large grains and small grains, it is the larger grains that have the greater influence. When the sand is composed of spherical grains and angular grains, it is the angular grains that have the greater influence, and this is in the direction of less permeability. With regard to the influence of clay, it is shown that the greatest permeability corresponds to 7 to 8 per cent of clay for spherical grains as well as for angular grains of 0.006-inch diameter. He also found that 7 to 8 per cent water produced maximum permeability. Another diagram shows that permeability decreases as the proportion of coal dust increases.

The author has studied the relations between the various methods of ramming and moisture content. He shows that the most uniform ramming is obtained by jolting, except when the sand does not contain sufficient water. It also is shown that the local density of the sand after ramming, for sands of similar structure and moisture, content is influenced greatly by the methods of molding and by the height of the flask. The author shows that the permeability of dry sand molds is less than can be obtained by adding a certain amount of water to the green sand.

Artist-Foundryman *Learned His Trade* In France

JULES BERCHEM
—a master molder

LIVES of great men, as the late Mr. Longfellow pointed out with considerable acumen, teach us how to make our lives sublime, but only a relatively small number, if any, commenced that arduous task at the age when Jules Berchem, American Art Bronze Foundry, Chicago, set himself to climb the hill of fame. Regard, my friend, the beginning of the grand adventure when the chubby little bright eyed boy at the tender age of nine years was indentured as an apprentice in a Parisian foundry devoted to the production of works of art. He took to the work, as the saying goes, like a duck takes to the water, and for a period of over 60 years he has applied himself diligently to an art that has reflected credit on his inventive and mechanical ability and that has elevated him to the front rank of those who transmute the sculptor's dream into enduring objects of three dimensions.

Modest and unassuming, he looks upon the work of his hands, scattered throughout the length and breadth of the country and is well pleased. In addition to innumerable smaller pieces the list includes: Soldiers' and sailors' monument—top figure 42 feet high—Indianapolis, Ind.; silver statue of Justice for the state of Montana; soldiers' and sailors' monument, heroic size, Des Moines, Iowa; statue of *herald* for Herald building, Chicago; soldiers' and sailors' monument, Rochester, N. Y.; soldiers' and sailors' monument, Winchester, Ind.; Indiana monument tablets, Military park, Miss.; statue of Hans Christian Anderson, Chicago; equestrian statue of St. Louis, Forest park, St. Louis; Illinois monument, Andersonville, Ga.; naval monument, Vicksburg, Miss.; soldiers' and sailors' monuments at Wichita, Kans., and Princeton, Ill.; bronze lions in front of the Art Institute, Chicago; Great Lakes fountain, Chicago; Kosciuszko monuments, Chicago and Washington; McPherson equestrian statue, McPherson, Kans.; Thatcher memorial fountain, top figure 17 feet high, Denver, Colo.; Alma Mater group recently erected on the campus of the University of Illinois, Urbana, Ill.

Jules Berchem was born Dec. 9, 1856 in the city of Paris, France, and although he has acquired a working knowledge of the English language during his many years residence in the United States he still prefers the smoothly flowing, flexible, rapid mother tongue with its slurred syllables and tonal inflections for conveying the nicest shades of meaning.

"Angleesh for biziness, for work for what you call rough stuff, maybeso, yes. For pass on finer thought, for two friend converse, for art, for leeter-*at*-ture, for pleasure," an expressive shrug *"mais non!"*

As a recognized master craftsman he left his native city at the age of 29 and worked for 18 months in New York. In 1886 he moved to Chicago where he shortly afterward opened a small shop at 42 Michigan street. Financial backing and encouragement were supplied by a generous member of the Chicago fire department greatly attracted by the young artist's ability. His first order was for a statue of Schuyler Colfax, vice president of the United States during General Grant's first term. This may or may not have influenced the maker in his choice of affiliation with the Republican party. Idea respectfully referred to membership committee!

Perfection of this casting attracted the attention of men about to erect a monument to the memory of policemen killed in the famous Haymarket riot a few years previously. He was awarded the contract. A silver statue of Justice cast from native silver was the outstanding feature in the exhibit staged by the state of Montana at the Columbian Exposition in Chicago in 1893. It was molded and cast by Jules Berchem in his plant at Grand Crossing to which he had moved in 1899. Later he moved to a larger plant on West Fulton street where he remained until 1905. In that year he built his present large and modernly equipped plant on West Lake street.

His only son Alfred, in 1916, commenced his apprenticeship under the fostering eye and hand of his accomplished father and gradually assumed the business adminstration of the enterprise, leaving his father free to devote his entire time to the technical details of an art to which he has devoted his entire life time.

New England Founders Elect Officers

The New England Foundrymen's association celebrated its thirty-fourth anniversary at the meeting held Jan. 8, at the exchange club, Milk and Batterymarch streets, Boston. Several fine entertainment features followed the dinner. New officers elected at the meeting were as follows: Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass., president; Luther J. Anthony, Glenwood Range Co., Taunton, Mass., vice president; G. H. Gibby, Gibby Foundry Co., East Boston, Mass., treasurer; Fred F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass., secretary. Members of the executive committee are: Warren D. Kent, Grinnell Co., Providence, R. I.; Albert Sweet, Milford Iron Foundry, Milford, Mass.; Roy M. Sherwin, Browne & Sharp Mfg. Co., Providence, R. I.; Fred D. Shaw, Walker-Pratt Mfg. Co., Watertown, Mass.; Charles A. Reed, Rogers, Brown & Crocker Bros. Inc., Boston.

Rudolph Nelson has become affiliated with the U. S. Electrical Tool Co., Cincinnati. Mr. Nelson's headquarters will be the Chicago office of the company.

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Let's Get in Step

A STANDARD cost system long has been recognized as a pressing need of the gray iron industry in meeting present day competition. Two years ago, when the first efforts were made toward the establishment of a trade association for the gray iron group, leaders in the movement pointed to cost work as one of the first steps to be undertaken by such an organization. Now, after a year's intensive study on the part of its cost committee, the Gray Iron institute has presented its standard cost system to the industry. A portion of this important contribution is included in this issue of THE FOUNDRY, and the remainder will appear in early issues.

THE standard cost system for gray iron foundries represents the combined knowledge of practical foundrymen and cost experts who have been connected in some capacity with the gray iron industry. It is composed in part of the best points included in cost systems now in use by individual foundries and by groups in various localities. It has been built primarily for the small shop, and then has been enlarged to meet the demands of the larger foundry, where the needs are greater for detailed cost information covering the many ramifications of the business.

RESPONSIBILITY for further advances in the cost program rests with the individual foundries, whether members of the institute or not. If each gray iron foundry in the United States will study the standard cost system to determine any points of difference between it and the particular system now in use, and then will make the necessary changes to make its system conform to the standard cost system, the gray iron industry as a whole will have made a big step in meeting today's competition.

¶ Index Is Ready

AN INDEX of all articles published in THE FOUNDRY during 1929 has been prepared for distribution. The index gives complete references and cross-references to all articles which have appeared in each of the 24 issues. Readers who bind or preserve the past issues of this publication will find the index of value when referring to articles which have been published. A copy of the index will be mailed free of charge to any reader who requests it from THE FOUNDRY, Circulation Department, Penton building, Cleveland.

¶ All in the Same Boat

TOURING foundrymen from all parts of the United States and Canada usually drop into the office of THE FOUNDRY if their itinerary takes them through or in the vicinity of Cleveland. The same practice holds with foundrymen from foreign countries whose business, or pleasure, or combination of both, brings them to the United States. The pleasure is mutual. The staff of THE FOUNDRY is glad to place knowledge and facilities for securing information at the disposal of visitors. The visitors in return discuss conditions in their own district or their own country and in that way pour information into the common treasure chest. After all, many of the problems, trials and accomplishments know no national boundaries.

DURING the recent foundry exhibition held in Dusseldorf, Germany, the central motive, education, was illustrated in one of the halls where a series of seven large paintings on the walls showed what purported to be the seven cardinal sins of foundrymen. The first showed workmen trying to carry on in darkness and dust, the second depicted high priced molders doing laborer's work, the third showed the wastefulness of employing ovens beyond the capacity required, the fourth dealt with men laboriously carrying iron instead of employing a crane, the fifth illustrated the uneconomical policy of trying to melt iron with an inferior grade of coke, the sixth showed a casting lost for the second time presumably for want of profiting by experience with the first and the seventh illustrated the slow and clumsy methods of cleaning castings by hand instead of using pneumatic equipment. Commenting on this, a German visitor to this office recently remarked bitterly that the artist should have added one more picture to the collection; one showing high costs of labor and materials, low prices for castings and not enough work in the country to keep the foundries running at half their capacity. Was it not Wesley who viewing the drunkard in the gutter, said "There, but for the grace of God, lies John Wesley."

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

O B. WILLIAMS, for the past 10 years associated with the Bessemer Gas Engine Co., Grove City, Pa., as general foundry foreman and assistant superintendent, has taken a position as general foreman of the core department for the John Deere Tractor Co., Waterloo, Ia. Prior to his association with the Bessemer company, Mr. Williams was connected with the E. W. Bliss Co., Brooklyn, N. Y., as general foreman of the core room for four years and with the Mesta Machine Co., Pittsburgh, for two years. He began his foundry career at the old plant of the Westinghouse Electric & Mfg. Co., Cleveland.

George Simes, formerly general pattern shop foreman, Alliance works, American Steel Foundries, has been appointed assistant works manager of the Verona, Pa., works.

W. W. MacMillen, purchasing agent, National Malleable & Steel Castings Co., Cleveland, has been named chairman of the iron and steel committee of the National Association of Purchasing Agents.

Harry J. Broomhall has resigned as secretary-treasurer of the Master Craft Corp., Kalamazoo, Mich., to become assistant secretary-treasurer of the General Steel Castings Corp., Eddystone, Pa. Prior to assisting in the organization of the Master Craft Corp. in 1928, he was Pacific coast representative of Remington-Rand Inc.

William R. Beck has been made sales engineer of the Fort Pitt Steel Casting Co., McKeesport, Pa., manufacturers of carbon and alloy steel castings by the electric furnace process. Mr. Beck is a graduate of Case School of Applied Science and Western Reserve university, Cleveland. His experience includes engineering, iron and steel foundry practice, having been asociated during the past few years with several representative companies, in charge of engineering, metallurgical and sales departments.

J. B. Henry has resigned as vice president and director of the Union Steel Casting Co., Pittsburgh. He has been connected with the Union company since 1911, serving as vice president for the past 10 years. Previously he had been affiliated with the American Steel Foundries, Pittsburgh Steel Foundry and the United Engineering & Foundry Co. in both production and sales work. Mr. Henry joined the Union Steel Casting Co. as construction engineer in 1911 when the company doubled its capacity by erection of a new foundry unit. After the completion of this work he was appointed general superintendent.

The Foundry To Present Series of Articles on Engineering Properties of Gray Iron

DO YOU know that gray cast iron can be produced that has a tensile strength equal to wrought iron? It can be and is regularly produced by many foundries for special purposes as will be pointed out in a comprehensive series on the engineering properties of cast iron which will begin in the Feb. 1 issue of THE FOUNDRY. *What would you say if some engineer would state, "Isn't it true that cast iron with a strength of 20,000 pounds per square inch is considered a good metal and that if steel scrap is added to the charges, the tensile strength is raised to 44,000 pounds per square inch in only the rather small sections? That the tensile strength of ordinary gray iron is 15,000 to 18,000 pounds per square inch, and the better grade ranges from 20,000 to 30,000 pounds per square inch tensile strength?"*

You probably would have only an evasive comeback to offer, full of your sentiments on the subject, but would you have sufficient and accurate information available to refute his statements satisfactorily on practical and scientific grounds? The engineer will have to have something more definite than just your mere word as he actually is quoting material obtained from one of his ever constant companions, an engineering handbook.

During the past ten years considerable advance has been made in determining the various properties of cast iron. However, much of this information has been neglected both by foundrymen and engineers due to the apparent lack of consistency in published values, and to the necessity of studying a large mass of literature to obtain the essential details. Data to be presented in this new series has been obtained by comparing and correlating the information presented from time to time, and from some hitherto unpublished research work.

The introductory articles will enumerate the main characteristics and properties of gray iron that establish its worth with, a few specific examples of causes of casting failures, and will include information on the structure of cast iron. The following section will show the value of dividing the series of alloys called gray cast iron so that intelligent comparisons may be drawn between the different types. The fourth and fifth articles describe the elastic properties of cast iron while the sixth will present a digest of material relating to the transverse testing of cast iron.

Other articles to be presented will cover the specific gravity, electrical properties, formulating properties of cast iron from formulas based on certain elements of chemical composition, the shear test, hardness, etc. The remaining sections of the series will deal with methods of producing gray cast iron that will have properties desired for specific engineering purposes.

Obituary

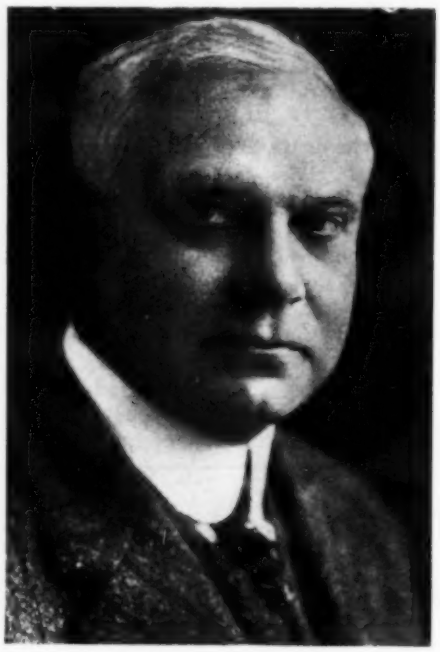
Archer A. Landon, president of the Landon Radiator Co. division of the Crane Co., North Tonawanda, N. Y., died Jan. 5 in a Buffalo hospital after an illness of several weeks. Mr. Landon was born in Detroit in 1868 and attended the schools of that city until he was 14. He then entered a railroad machine shop and later became a machinist in the Detroit plant of the American Radiator Co. In 1901 he was placed in charge of the Pierce plant of the American Radiator Co., Buffalo, and in 1905 he was appointed vice president and general manager of all the plants of the company. In 1920 he was appointed assistant to the president. During the war he was head of the Industrial Conference board, Washington, served as chief of the Aircraft Production board, as one of the special advisors to Secretary Wilson, and organized the War Labor board. In 1926 he organized the Landon Radiator Co., which later was taken over by the Crane Co., Chicago.

Theodore A. Martin, for the past seven years superintendent of the Farrell-Cheek Steel Foundry Co., Sandusky, O., died at his home in that city Dec. 25. Prior to March, 1920, he had been identified with the George H. Smith Steel Casting Co., Milwaukee. From 1920 to early in 1922, he installed a new steel foundry for the Erie Forge Co., Erie, Pa. He then returned to Milwaukee as manager of the Maynard Electric Steel Casting Co. He resigned later in that year to become superintendent of the Farrell-Cheek company.

Edward McSherry, for many years actively engaged in the foundry industry, died at his home in Freeport, Ill., Nov. 28. He was born in Mosinee, Wis., Nov. 15, 1861. In 1881 he went to Rockford, Ill., where he entered the employ of Emerson & Talcott Co. as an apprentice molder and was appointed foreman in 1887. In 1889 he resigned his position to become associated with Love Bros. Pump Co., Rockford, as foreman. In 1891 he became superintendent of the Rockford Foundry, later buying and conducting the business under the name of McSherry & Watson until the partnership was dissolved. He then entered the employ of Emerson-Brandingham Co., as assistant foundry superintendent. In 1889 he resigned this position to become general superintendent of the Stover Gas Engine Works and built a new foundry at that plant. He remained in their employ for 22 years. He then retired from active service and became associated with the Frieday Mfg. Co., as foundry manager and part owner until ill health caused his retirement in 1922.

Will Meet in Detroit

The first regional meeting sponsored by the American Society for Testing Materials will be held in Detroit, March 19, 1930. The meeting will be held under the auspices of the Detroit members of the society acting through the Detroit district committee of which Vice President F. O. Clements is chairman. Automotive materials will be the theme of the meeting and arrangements have been made for the presentation of twelve papers at the two sessions to be held at the Book-Cadillac hotel. Papers of interest to foundrymen to be presented at the morning session on metals will be, "Present-day Methods on Production and Utilization of Automotive Cast Iron," by A. L. Boeghold, General Motors Corp., Detroit; "Advances in Die-cast Metals and Alloys for Automotive Use," by Charles Pack, New York; "Developments in Light Metals and Alloys for Automotive Use," by Zay Jeffries, Aluminum Co. of America, Cleveland, and "Automotive Bearing Metals," by Clair Upthegrove, University of Michigan, Ann Arbor, Mich.



ARCHER A. LANDON

Thomas Fuller, formerly manager of the Charlotte, N. C., office of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed manager of the Atlanta district office, Atlanta, Ga., to succeed the late H. A. Coles.

Brass Founders Adopt Trade Customs

The Associated Brass Founders of New England, at a recent meeting, adopted a set of uniform trade customs which it is felt will go a long way toward removing causes of dispute and misunderstanding between members of the association and their customers. The subject has been divided into four general classifications: Estimating, patterns, castings and general and each of these sections has been summarized briefly under three items for three of them and under four in the fourth. The classification follows:

Estimating

1—Blueprints submitted to be marked with rough casting weight, either estimated or exact.

2—Quantity and quality of castings and specifications for metal to be clearly stated.

3.—If patterns have been made, complete pattern equipment should be shown or described.

Patterns

1—All patterns or pattern equipment necessary to economically produce quality, quantity and delivery of castings required to be furnished by or at expense of customer, properly marked for identification.

2—Responsibility for correctness of patterns, coreboxes and pattern equipment or any changes thereon, rests with customer.

3—Foundry not responsible for loss of or damage to patterns by fire or other cause beyond its control.

Castings

1—Defective castings to be replaced by foundry if reported within a reasonable time, full credit being allowed for piece or casting according to weight of material returned to the foundry.

2—No claim for machine work, labor or expense of any kind on defective castings allowed by foundry.

3—Claims for error in weight or number delivered to be made promptly upon receipt of castings.

General

1—Customer to be charged for castings, cores or molds discarded due to cancellation or change in pattern equipment.

2—All castings sold as rough castings f.o.b. foundry unless otherwise agreed, weight to be to nearest quarter fraction of a pound.

3—On transient work there should be a minimum charge of $1.

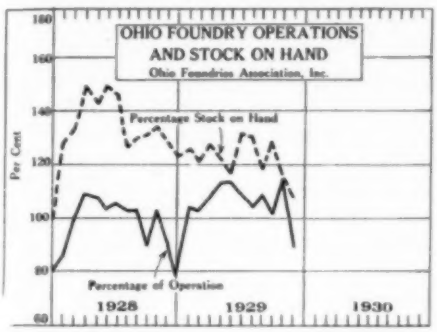
4—If customer requires special service to secure unusual deliveries, an extra charge should be made.

Trade Trends in Tabloid

FORECASTS on building construction for 1930, according to F. W. Dodge Corp., place the total expenditure for the current year at 8 per cent ahead of last year, but 3 per cent below 1928, the record year. Estimates on residential construction account for a large share of the expected increase in the total of 1930 over 1929. This should carry an increase volume of foundry business, both directly in plumbing, heating and household equipment and through the necessary extension of public utility services.

—T-T—

Stockholders of the Laconia Car Co., Laconia, N. H., have recommended



liquidation but the foundry will continue in operation.

—T-T—

Youngstown Foundry & Machine Co., Youngstown, O., which has operated at capacity for the past year, has orders on its books for several months' output.

—T-T—

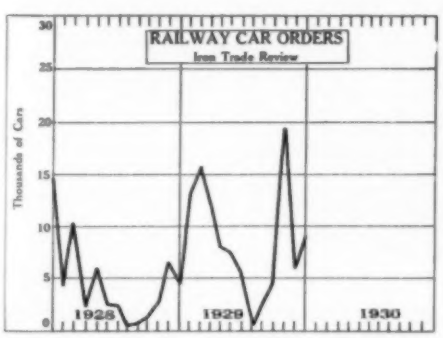
Buying of remelt aluminum is increasing in the Chicago district, although bookings to date have been light.

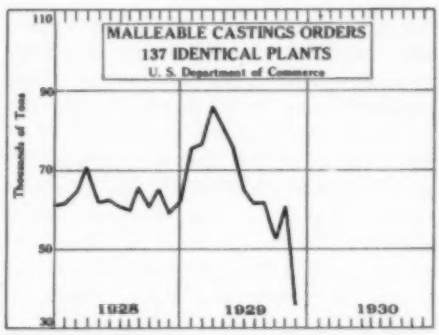
—T-T—

The Globe Stove & Range Co., Kokomo, Ind., reports 1929 as the best year in its history.

—T-T—

Net profits of the American Steel Foundries for 1929 will approximate the average for the past six years, which was over four million eight





hundred thousand dollars. Unfilled tonnage is smaller at this time than a year ago, but anticipated business, chiefly from railway sources, will make possible a high rate of operation from Feb. 1 until the middle of the year.

—T-T—

Jobbing gray iron and malleable foundries in the St. Louis district are buying iron. Stove foundries in that district are slowed or closed for inventory.

—T-T—

Brass foundries in the Chicago district are booked heavier than during the past few months with prospects bright for orders from the railway and industrial chemical lines.

—T-T—

Railway car orders in 1929 reached the highest total in recent years. Total awards for the year reached

RAW MATERIAL PRICES
Jan. 7, 1930

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	15.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.26 to 21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$16.00 to 16.50
Heavy melting steel, Pitts.	16.00 to 16.50
Heavy melting steel, Chicago	12.50 to 13.00
Stove plate, Buffalo	12.00 to 12.25
Stove plate, Chicago	10.25 to 10.75
No. 1 cast, New York	10.85
No. 1 cast, Chicago	13.50 to 14.00
No. 1 cast, Philadelphia	15.50 to 16.00
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	14.50 to 15.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	16.50 to 17.00
Agricultural mal., Chicago	13.75 to 14.25
Malleable, Buffalo	17.00 to 17.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.00
Electro, copper, producers	18.00
Straits, tin	39.50 to 39.62½
Lead, New York	6.25
Antimony, New York	8.37½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.25 to 16.75
Zinc, East St. Louis, Ill.	5.25 to 5.40

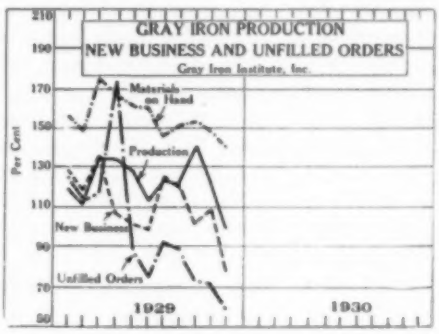
106,100 cars as compared with 44,763 cars in 1928. Much of the equipment ordered has not been manufactured so that companies specializing in this equipment should be busy during the first part of 1930. Inquiries are heavy with the Van Sweringen interests asking for bids on 10,625 freight cars.

—T-T—

Aluminum Industries Inc., Cincinnati,, reported sales for the last half of 1929 ahead of the corresponding period in 1928, by 35 per cent.

—T-T—

Automobile production is increasing gradually as manufacturers complete the necessary adjustments to make the new models. Production schedules for



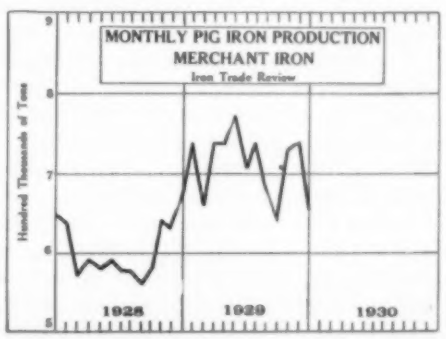
the next few months probably will be completed within a week or ten days as the buying public's acceptance of new models is noted at the New York and Chicago shows.

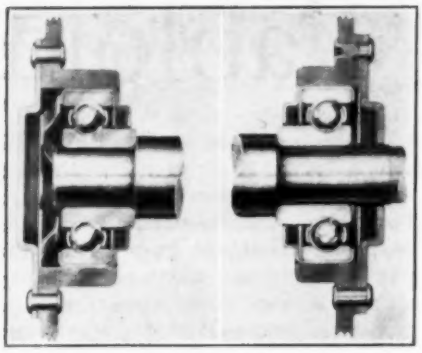
—T-T—

Merchant iron production dropped to the lowest point of the year in December with a total output of 661,343 tons. However, the total for the year was 8,584,963 tons as compared with 7,288,702 tons in 1928, a gain of 1,296,261 tons.

—T-T—

Average New York prices for nonferrous metals, during December, according to *Daily Metal Trade*, follow: Casting copper, 16.979c; electrolytic copper, 18.00c; Straits tin, 39.751c; lead, 6.250c; antimony, 8.425c; aluminum, 23.90c. Zinc averaged 5.675c, E. St. Louis, Ill.





TWO METHODS OF APPLYING NEW TYPE BALL BEARING

Lubrication Is Feature of Ball Bearing

New Departure Mfg. Co., Bristol, Conn., has placed on the market a self-sealed and self-lubricated ball bearing. It is made only in the smaller sizes and consists of what is essentially a single-row ball bearing of the nonloading groove type, permanently fitted into a metal case or shell. This shell is shaped on one side to contain a felt closure which fits over the ground outside diameter of the extended bearing inner ring, forming seal for the retention of lubricant and exclusion of dirt.

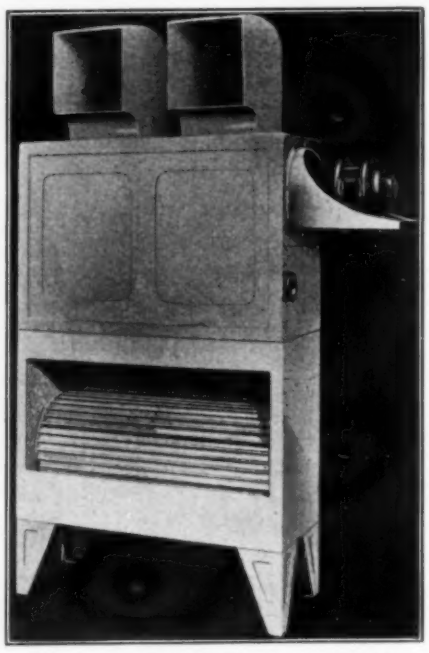
The inner ring is carried slightly beyond the face of the seal to facilitate removal of the bearing without damage and to prevent interference between shaft shoulder and seal. The overall width of the seal bearing is less than the space occupied by a standard bearing with a separate closure member.

Outside diameters and bores are standard. Capacity characteristics of the new bearings are substantially the same as corresponding sizes of nonloading groove single-row bearings. The accompanying illustration shows section views of two different applications of the seal bearing.

Air Circulator Adaptable to Patternshops

Buffalo Forge Co., Buffalo, recently placed an air heater and moistener on the market. This heater, which is shown in the accompanying illustration cleans, moistens and heats the air and is adaptable to patternshops and patttern storage vaults. It consists of a revolving drum with plates to wash and scrub the air as it flows through the apparatus. The vanes are propelled by the current of air through the machine and scrubber plates are dipping continually in a water tank which gives them a wetted surface through which the air must pass twice. Any dirt in the air settles into a tank where it may be washed from the machine into the drain. The water level in the tank is maintained automatically by a float.

The multi-rotors are of the centrifugal type, each with its fan housing, designed to deliver a large volume of air. The motor and shaft assembly may be removed through end plates without disturbing the top of the casing or the fan housings. The motor bracket end plate and the outboard end plate are interchangeable so that the drive may be placed at either end. A light weight heater made of copper and brass tubing is



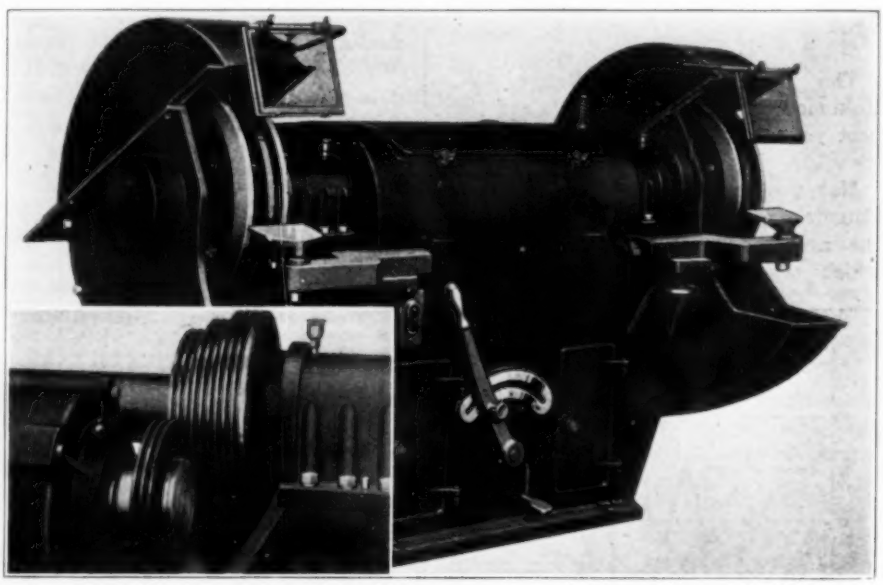
THE AIR IS CLEANED AS IT PASSES THROUGH THE DEVICE

used to heat the air passing through the apparatus. The heater element may be removed from either end through plates and may be assembled with steam or drip connections on either end.

Speed Control Device Is Feature of Grinder

United States Electrical Tool Co., Cincinnati, recently has placed on the market a new type grinder that embodies the V-disk transmission principle. The drive is made of micarta disks impregnated with graphite. It is designed to give positive action with no slip. The disks are durable, accessible and have a low replacement cost.

One of the advantages claimed for the new grinder is its ability to operate on alternating current. Another advantage is that it will maintain an average wheel speed of approximately 9000 feet per minute using vitrified or high speed wheels worn down to the flanges. This is made possible by two changes of spindle speed. These are accomplished by a foot pedal and hand lever conveniently located at the front of the machine as shown in the accompanying illustration. This operation lifts the metal transmission disk attached to the motor spindle and replaces it in the smaller disks on the wheel shaft. The hand lever is interlocked with the guards, making it impossible to run the wheels at excessive speeds. Other features of the machine are four heavy duty ball bearings enclosed in dustproof housings, chrome manganese steel shaft, push button control with no voltage release and overload protection, unbreakable glass eye shields, adjustable tool rests, and electric steel or boiler plate wheel guards as desired, with exhaust connections for the removal of dust.



THE MACHINE MAINTAINS THE AVERAGE WHEEL SPEED OF 9000 FEET PER MINUTE WHEN THE WHEELS ARE BADLY WORN

The grinder is made to carry 18 x 2, 20 x 2, 24 x 3 and 30 x 3-inch wheels. It is supplied for 220, 440, 550 volt; 25, 30, 40, 50 and 60 cycle, 2 or 3 phase alternating current operation.

Appointed Secretary of New England Group

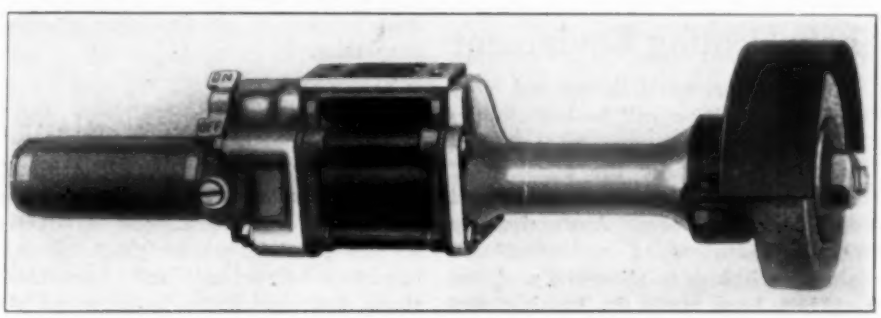
Ray M. Hudson, formerly assistant director, bureau of standards, commercial standardization group, has resigned to become secretary of the Massachusetts division, New England council, with headquarters in Boston. Mr. Hudson was graduated from Syracuse university in 1908 and since that time has been engaged in the commerce standardization field specializing in simplification, standardization and scientific management. Prior to his connection with the bureau of standards, Mr. Hudson was associated with Col. George D. Babcock. During the war he served as production engineer with the Emergency Fleet Corp. Mr. Hudson is a member of the Taylor society, Society of Automotive Engineers and many other societies and committees.

Constructs Laboratory

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has begun the construction of a new $1,500,000 central engineering laboratory and an addition to the present direct current power laboratory. The main building will be 80 x 225 feet and the direct current laboratory will be extended 125 feet. The upper six floors of the building will be used for engineering offices and the remaining floors will house miscellaneous experimental work.

Grinder Operates Simply

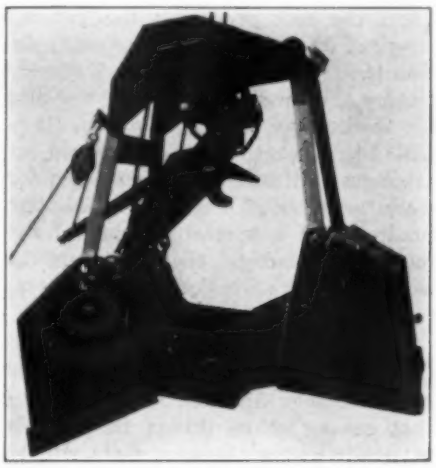
Rotor Air Tool Co., Cleveland, has introduced a new type grinder designed especially for 1 x 4 inch grinding wheels. It is constructed for light grinding on a bench or in close quarters and may be used for the heavier type of die grinding. Two models are provided. One has a free speed of 6000 revolutions per minute for vitrified wheels and the other has a speed of 8000 revolutions per minute for rubber or bakelite bonded wheels. Both models are equipped with a governor that controls the free speed and reduces the air consumption. The machine has only three moving parts, which it is claimed is a contributing factor to its low maintenance costs. The pneumatic grinder is shown in the accompanying illustration.



TWO MODELS GIVE SPEEDS OF 6000 AND 8000 REVOLUTIONS PER MINUTE

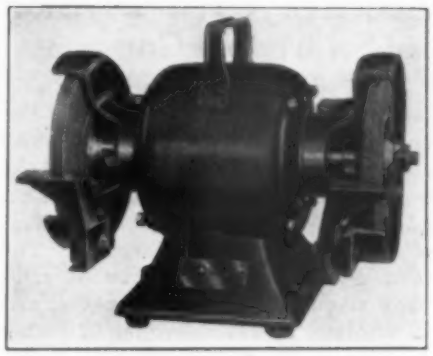
Builds Grab Bucket

Edgar E. Brosius, Inc., Sharpsburg, Pa., recently has placed on the market a new one-half cubic yard capacity, single hook, grab bucket. The apparatus is built of plates and structural shapes and is electrically welded throughout. The lips are made of manganese steel and are riveted to the scoops. It can be attached to any crane or hoist easily and can be tripped from the operators cage or from the ground. It opens without shock to the crane or bucket. The latching mechanism is simple.



THE BUCKET EASILY IS ATTACHED TO THE CRANE HOOK

G. A. Reinhard has been appointed Cleveland representative of the Dings Magnetic Separator Co., Milwaukee. He will have offices at 1836 Euclid avenue.



THE BENCH GRINDER HAS ANTIFRICTION BEARINGS

Designs New Grinder

The description of the bench grinder made by the Black & Decker Mfg. Co., Towson, Md., which appeared on page 132 of the Jan. 1 issue of THE FOUNDRY, inadvertently was accompanied by an illustration of a portable type grinder built by the Rotor Air Tool Co., Cleveland. The new 6-inch, ball bearing, portable, electric grinder built by the Black & Decker company is shown in the accompanying illustration. The machine is equipped with antifriction bearings, making it easier to maintain the wheel speeds under load. It is fitted for alternating current only, giving a 3600 revolution per minute spindle speed on 60 cycles and 3000 revolutions per minute on 50 cycles.

Compares Trade Customs

Ohio Foundries Association Inc., 418 Penton building, Cleveland, recently has issued a 16-page booklet comparing foundry trade customs and sales agreements of various foundrymen's organizations. The data given in the booklet was compiled with a view to formulating a set of foundry trade customs and sales agreements that would be applicable to the whole foundry industry. The material of such agreements is compared under the following heading: General comparisons; estimating requirements for quotations; condition of pattern equipment; correctness of patterns; identification of patterns and core boxes; freight, cartage, boxing and crating of patterns; pattern loss by fire; pattern storage; replacement of castings, defective castings; claims for error; terms; special service; changes in orders; liabilities in case of fires, strikes, etc.; cancellation of orders; acceptance of quotations; quotations on various classes of work and many other heads.

Sullivan Machinery Co., Chicago, recently has completed an addition to its plant at Michigan City, Ind.

Acquires Oven Division of Swartwout Company

The Foundry Equipment Co., Cleveland, which for a number of years has specialized exclusively in the design and construction of foundry ovens for baking cores and drying molds, recently acquired the industrial oven department of the Swartwout Co., Cleveland. The oven division of the Swartwout company manufactures foundry ovens, and in addition, an extensive line of industrial ovens for paint drying, japanning, processing, etc. The consolidation of the two companies will enable the

O. D. CONOVER

Foundry Equipment Co. to serve completely the industrial oven field. The technical staff of the Swartwout company has been retained and will operate the department as the Swartwout Industrial division of the Foundry Equipment Co. The division will be directed by Carl F. Mayer, formerly manager of the industrial oven department of the Swartwout Co.

The business of the Foundry Equipment Co. has been expanding constantly. Recently it has constructed a battery of 46 ovens together with a complete oil combustion system for the Lycoming Motor division of the Auburn Automobile Co. The company also has designed and will begin installation in the near future of a large continuous unit for the General Steel Castings Corp., Eddystone, Pa. The unit will be about 250 feet in length and will cost in the neighborhood of $250,000. The company also has contracts for oven equipment to be installed in Russia.

Officers of the company are as follows: Julius Tuteur, chairman of the board, Charles A. Barnett, president, O. D. Conover, vice president, A. V. Cannon, secretary and A. F. Woehrmann, treasurer. The main office and plant of the company is located at 1831 Columbus road, and additional office space has been taken in the Perry Payne building.

Steel Founders' Society To Discuss New Uses

The January meeting of the Steel Founders' Society of America Inc. will be held in Chicago on Jan. 28 at Hotel Sherman. An unusually interesting program has been arranged which, among other things, will include a discussion of new applications recently developed for cast steel. It has been recognized that, with the rapid advancement in the art of casting steel, many new uses have been developed which should be known to steel foundrymen generally.

On the day preceding the general meeting, the cost committee will devote the entire day to the work of perfecting uniform cost-finding methods for steel foundries. In addition, there will be a meeting of the board of directors and three group meetings for manufacturers of large and small steel castings and a special division of the society devoted to the producers of heat, acid and corrosion-resisting metal products.

H. J. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa., chairman of the small castings division, has announced that among other things the subject of repair or maintenance costs will be discussed. A paper on this subject will be presented by C. A. McDonald, Nugent Steel Castings Co., Chicago, and a summary of actual maintenance costs for the various group members will be studied and analyzed. The society's committee on industrial research hopes to have a revised set of standard trade customs ready to present to the board of directors and the members at the meeting. The usual reports on general business conditions will be a feature of the general session.

Show Heating Equipment

The International Heating and Ventilating Exposition will be held in the Commercial Museum, Philadelphia, Jan. 27 to 31, under the auspices of the American Society of Heating and Ventilating Engineers. Approximately 300 manufacturers of equipment will maintain displays to show the progress that has been made in heating and ventilating every type of building.

Committees Report

The outstanding achievement of the American Society for Testing Materials committee A-3 on cast iron during the year 1929, was the symposium of 12 papers on the physical properties of that metal presented at the annual meeting of the society in Atlantic City, N. J., according to Hyman Bornstein, Deere & Co., Moline, Ill., chairman. That committee is planning an extensive investigation on impact testing of cast iron during this year.

According to J. B. Johnson, chief,

C. A. BARNETT

material section, air corps, U. S. A., Wright field, Dayton, O., chairman on the committee B-7 on light metals and alloys, cast and wrought, the tentative specifications for aluminum ingots for remelting and for aluminum sheet have been advanced to standards.

It was found necessary to revise the tentative standards for aluminum base alloys as the list contained several analyses that had become obsolete. These specifications have been revised totally. The list now includes not only the foundry alloys most commonly used but also alloys which are heat treated to develop high physical properties.

Completes New Plant

Stuebing Cowan Co., Cincinnati, subsidiary of the Yale & Towne Mfg. Co., Stamford, Conn., has completed its new plant in Winton place. It is a one-story structure and has three times the production facilities of the old plant.

Determines Grain Size

(*Concluded from Page* 80)

be done by introducing coarser grains in the lower range of the curve. The best example of the relationship of bond and grain size is shown when the boiler sand mentioned was modified into sand suitable for manufacturing firepots. To meet a special condition of a 3/16-inch metal thickness between sand surfaces 3 feet long, a higher bond sand was desired. Adding more bond to the regular boiler sand not only closed up the sand, but caused swelling in the mold. Swelling takes place when bond is in excess of the requirements for just coating the grains and is due to the expansion of the excess claymatter when in the process of dehydration. The sand was improved by introducing a coarser sand in the mixture with the result shown in Fig. 5. Another point that lends to the effectiveness of bond in a sand is uniformity of distribution. With natural molding sand, distribution is not often a problem because the bond is produced *in situ* by weathering and other geological processes, but when using rebonding agents whether they be clays or claysands they should be processed so as to distribute themselves throughout the heap uniformly. This insures greater permeability for a given grain size and less danger from swelling due to localized glomerates of extra bond.

Fig. 6 illustrates a problem in brass foundry making plumbers' hardware. The heap was a mixture of two sands; a coarser one for the base and a finer sand for bond. The curve presented was smooth which would seem ideal and it would have been so, had it been higher in bond. The finer sand did not have enough actual colloidal matter in it to furnish the proper percentage of bond without closing up the heap of excess fines. A bond sand with higher clay content improved the condition but the final solution probably will be obtained through a single sand of higher content represented by the second curve. This is the curve of a new sand and should be a little coarser than the final result desired in the heap which is shown by the first curve. A general rule for estimating bond requirements in a new sand is to count on the new sand being 2 to 5 per cent higher in bond than the final bond content of the heap. The bond content in this particular sand would not drop more than 2 per cent because the heat conditions were not so severe.

Fig. 7 shows the difference between a fine sand which was responsible for dirt wash and poor results in drawing the pattern and a more open sand which gave good results. The castings were aluminum bronze and poor venting prevented gas from escaping and boiling resulted. The reason for low permeability can be seen from the fact that 86 per cent of the grain residue went through a 270 mesh screen. This may have been the cause of the sand sticking to the pattern especially on deep draws. At any rate the coarser sand overcame the difficulties and produced just as smooth work.

The author finds that smoothness of surface is not always proportional to the fineness of the sand. If this were true, dust from the gangway in the shakeout room would be a useful ingredient in a molding sand for it is mostly granular matter from broken down grains and dehydrated bond. Smoothness depends rather upon a smooth gradient of grain size based upon the mathematical curve that has been described. It may be noticed that when curve 2 does start to rise the last four points plotted on the 100, 150, 200 and 270 mesh spaces occur in almost a straight line. When this condition combined with the proper amount of bond, uniformly distributed, is obtained, a sand is found of just the right combination of compactness and permeability to give good results. When a more open sand is desired the curve should be moved to the left bodily and not piecemeal such as for example introducing 10 or 20 per cent of coarse sand in the 20 to 65 mesh range leaving the base of the sand still containing fine material. Whatever the position of a curve may be on the chart, it should present something resembling a straight line or smooth curve over the last 80 per cent of its rise.

Anyone undertaking sand investigation by the ultimate screen analysis, such as has been described, must not consider that this is a routine test, for it would probably take too long. Rather he should consider this as a method of arriving at a rugged condition in his heaps. It stands to reason that once a certain grain distribution is arrived at in a heap of many tons of sand no minor changes are going to change its properties overnight. This is especially true if the regular sand additions to the heap are from a source with a grain distribution of the same type. To borrow a word from the psychologist—a sand heap has character and many vicissitudes will be withstood before any essential change is effected in this quality. Only one phase of the sand problem has been taken up but the author feels that it is an important one. There are other qualities in sand grains other than uniform distribution in screen analysis and these are the shape of the individual grain and refractoriness. There are other qualities in a bond other than uniform distribution and these are refractoriness and strength of the bond itself. This was brought out in a paper by Brown and DeWitt at the 1928 convention of the American Foundrymen's association in which they showed that the presence of a film of hydrated iron oxide which occurred naturally on each individual grain aided the strength and tempering properties of a molding sand.

Faked Foundry Facts

Sand Thrower

Philadelphia Group Meets

The Philadelphia Foundrymen's association was addresed at its regular meeting, Jan. 8, held at the Manufacturers' club, by Oliver Smalley, metallurgist, Meehanite Metal Corp., Chattanooga, Tenn. Mr. Smalley discussed foundry problems, particularly in connection with melting and mixtures. Dr. F. H. Green, well-known humorist, addressed the foundrymen on "The Spirit in Which to Work."

During 1928 the United States exported 15,728,281 pounds of crude and semicrude aluminum valued at $3,758,-728 and manufactured goods such as castings, tubes, etc., to the value of $3,132,762.

Primary zinc produced in the United States from domestic ores in 1928 amounted to 591,525 short tons valued at $72,166,000.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

The foundry of the Robbins & Myers Inc., Springfield, O., recently was damaged by a fire.

Haskell & Barker plant of the Pullman Car & Mfg. Co. may reopen the Haskell & Barker brass foundry, Michigan City, Ind.

E. T. Pybus Co., Wenatchee, Wash., is having plans prepared for a foundry to be erected in South Wenatchee, Wash.

Standard Brake Shoe & Foundry Co., West Pullen street, Pine Bluff, Ark., will enlarge its foundry although the date is indefinite.

Agricola Furnace Co., Gadsden, Ala., manufacturer of house heating furnaces, has started erection of a large foundry addition.

Chapman Valve Mfg. Co., Indian Orchard, Me., expects to erect a 75 x 152 foot plant addition.

Pueblo Brass & Iron Foundry, Greenwood street and North Victoria avenue, Pueblo, Colo., may enlarge its plant facilities and contemplates installing new equipment.

Central Texas Iron Works, Waco., Tex., operating a foundry and makers of structural steel, recently acquired a site for possible expansion at Abilene, Tex.

Sandwich Foundry Ltd., Sandwich, Ont., will start rebuilding at once that portion of the plant recently damaged by fire. Estimated loss is $250,000.

Arrow Head Steel Products Co., 180 Hopkins street, Buffalo, will probably build a 1-story forge shop and foundry to cost $100,000. E. A. Earle is plant manager.

United Dry Docks Inc., Mesereau and Davidson streets, Port Richmond, N. Y., contemplates building a foundry and shop estimated to cost $80,000.

Vermilion Malleable Iron Co., Hoopeston, Ill., plans the construction of a 1-story foundry addition at North Sixth street and Nickle Plate railway. F. C. Moore is manager.

Wilcox, Crittenden & Co. Inc., 3 South Main street, Middletown, Conn., has awarded the contract for the erection of a one and 2-story foundry and boiler house addition to T. H. Sellew, Cromwell, Conn. (Noted Jan. 1.)

Chattanooga Stove & Foundry Co., Chattanooga, Tenn., will erect a modern stove and foundry building at East Lake, Tenn., to cost $200,000. J. E. Abshire, Chattanooga, Tenn., is president.

National Iron Corp., Ltd., Cherry street, Toronto, Ont., manufacturer of cast iron pipe is planning a fuondry addition to cost $50,000. James, Proctor & Redfern, 36 Toronto street, are engineers.

Huron Gray Iron Foundry Co., Ypsilanti, Mich., is planning an additional building to house the cleaning and sandblasting machinery which will be moved from the main plant to facilitate expansion.

S. E. Dinsmore & Co., Security building, Windsor, Ont., has been awarded contract for the erection of a foundry at 400 Bloomfield road, Sandwich, Ont., estimated to cost $150,000. Pennington & Boyd, Security building, Windsor, are architects.

Electric Auto-Lite, Sarnia, Ont., has been incorporated to manufacture and deal in mechanical and electrical appliances and metal products with $500,000 capital stock by Charles S. Woodrow, Charles E. Woodrow, John R. Donohue, all of Sarnia, Ont.

Duriron Co., Inc., North Findlay street, Dayton, O., contemplates construction of a plant addition to contain modern equipment for analysis and testing, an experimental foundry, rolling mill, and machine shop. Plans are nearing completion. (Noted Jan. 1.)

Montpelier Foundry & Machine Co., Montpelier, Ind., recently was sold to D. D. Hensel, attorney acting for W. C. Spurgeon of the Muncie Gear Co. and the Indiana Foundry, Muncie, Ind. The foundry will be equipped for the production of large castings. New equipment is being purchased.

San Antonio Machine & Supply Co., San Antonio, Tex., has purchased the D. June Machinery Co., Waco, Tex. The new owners will operate the plant located at First street and Franklin avenue but will dispense with that operated at Ninth street and Franklin avenue. Carl C. Krueger is president of the San Antonio company.

Bearium Bearings, Inc., Rochester, N. Y., has been absorbed by the Universal Bearing Metals Corp. with general offices at 258 State Street, Rochester, N. Y. The facilities of the company have been increased. The Johnson Bronze Co., New Castle, Pa., have been appointed producers of bearium bushings. E. P. Langworthy is president of the company.

Caterpillar Tractor Co., Peoria, Ill., will add 2000 to 3000 employes within the next 90 days in its enlarged thresher-combine and tractor factories and foundry which are nearing completion. It is stated that the increased facilities of the Peoria plant will make a total payroll of over 6000 to 7000. R. C. Force is president of the company.

Centrifugal Steel Inc., Sandusky, O., has been incorporated with 50,000 shares of capital stock to take over the rights of a centrifugal steel casting process developed by W. H. Millspaugh, who will head the new concern. Mr. Millspaugh was formerly president of the Paper & Textile Machinery Corp. Rights to the process were retained when the company was acquired by a large paper machinery interest. There are no plans for immediate development.

McNally-Tollefson Co., Stoughton, Wis., manufacturer of gray iron castings, has arranged for a merger of interests with the Stoughton Co., also of Stoughton. The McNally foundry will take over all of the gray iron work of the Stoughton Co. shop, which in future will devote its attention to nonferrous products, principally brass and aluminum castings. For some time past the McNally foundry has been operated by the Liberty Foundry Co. Inc., Wauwatosa, suburb of Milwaukee, but it was shut down several weeks ago. It occupies a unit of the old Moline Wagon Co. plant, now owned by the city, under a lease that has about two years to run. John E. McNally is general manager.

New Trade Publications

SWITCHES—Allen-Bradley Co., Milwaukee, has published a folder on the various types of switches it manufactures and their uses.

AIR COMPRESSORS—General Electric Co., Schenectady, N. Y., has published a series of bulletins on its single and two stage, portable and stationary, reciprocating air compressors.

TRAMRAILS — Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has issued a folder on the utilization of its equipment for cleaning room, storage and shipping facilities.

CHIPPING HAMMERS—Ingersoll-Rand Co., 11 Broadway, New York, has issued a folder on its new line of high speed, pneumatic chipping hammers. The folder contains views of the various types that make the complete line and shows sectional illustrations of the machine.

SAND TESTING—Harry W. Dietert, Box 1506, Detroit, has issued a folder on his line of sand testing apparatus. The booklet contains illustrations and descriptions of the machines, line drawings and instructions on the operation and maintenance and a price list of the equipment.

CONTROLLERS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a 4-page folder on its 2 to 100-horsepower, 115 to 550 volt, direct current, drum controllers. Application, distinctive features, operation and construction of the apparatus are illustrated and described.

COMPRESSORS—Chicago Pneumatic Tool Co., New York, recently has issued an 8-page folder on its vertical duplex compressors. The features and advantages of the machine are explained. The folder is well illustrated with assembled views and phantom views which show the design. Details of construction are illustrated with views of the various parts.

HOISTS—Robbins & Myers, Inc., Springfield, O., has issued a booklet on its new type electric hoists. The catalog contains illustrations and drawings of the machine and typical installations. Tables give the specifications of the various sizes of hoists and phantom and disassembled views show the construction of the machine.

CONVEYORS—Standard Conveyor Co., North St. Paul, Minn., has published a catalog of its conveyor equipment. The booklet contains illustrations of the various types of equipment that it manufactures and gives uses, advantages and applications to specific industries. A section of the catalog is devoted to illustrations of typical installations and another part contains working drawings of the various sections of the equipment.

ROLLER CHAIN DRIVES — Link-Belt Co., Chicago, has completed a 96-page book of information on the roller chain drives it makes. The illustrations in the book include those of various types of roller chain with tables of specifications, sprockets and views of typical installations. Engineering data regarding the size chain for various dimensioned sprockets developing different horsepowers, specifications of sprocket wheels, hub data and tables for determining length of chain are included.

CHAIN HOISTS AND TROLLEYS—Ford Chain Block Co., Philadelphia, recently has published a 31-page booklet on the hoists and trolleys it manufactures. The advantages and features of the hoists are explained and illustrated and tables give various information on efficiency of different type chain hoists. Many illustrations show typical installations. Other tables show the dimensions and costs of the different hoists and trolleys made by the company and also information on the various parts.